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THE ELECTRICAL TRANSMISSION OF POWER.

SOMETHING at least has been gained by M. Marcel Deprez's Grenoble experiments, for we find that the committee of investigation admits a loss of from five to seven per cent. due to leakage over a line of only 14 kilometres in length. From the commencement of M. Deprez's work on the electrical transmission of power we have, in common with several foreign contemporaries, pointed out that leakage on an ordinary telegraphic line is very considerable for long distances; yet, until the recent experiments were made at Grenoble, the French engineers have studiously avoided taking this matter into consideration. It must be borne in mind, however, that the Grenoble line was of special construction, and that on the usual wires employed in telegraphy the percentage of leakage would be found to be considerably higher. Our readers are aware that in the above experiments the examining committee made two reports, one on the dynamometrical measurements, the other relating to the electrical tests. In the interests of electrical science we trust that the committee will see its way to the publication of a third report, in which the two systems of measurement may be compared. The experiments on the *distribution* of power appear to have been conceived in a truly farcical spirit. Instead of the inhabitants of Grenoble being gratified by seeing in operation lathes, band saws, printing presses, &c., driven by electricity, produced at the Vizille end of the line, we learn that the motive power was produced by an engine stationed on the spot. When will M. Deprez and his supporters favour the electrical world with a series of experiments free from all suspicions of charlatanism?

ELECTRICAL APPARATUS FOR ENUMERATING PHYSIOLOGICAL MOVEMENTS.

WE have been favoured with a very interesting report made by Dr. Francis Warner, Assistant Physician to the London Hospital, &c., to the Scientific Grants Committee of the British Medical Association, on methods and apparatus for obtaining graphic records of movements of the limbs, &c. The instruments for this purpose, devised by Dr. Warner, are very ingenious, and his investigations appear to be of a highly valuable character. The report reads thus :—

Most of the movements of the body are the outcome of the action of the central nerve-mechanism; hence those movements produced by the hidden central organ are the signs of the action of that organ; and movements of the limbs, head, &c., may be studied with advantage as the indices of the brain. On these grounds, the following postulate may fairly be granted. "If we see some spontaneous nerve-muscular action often repeated in the same and in different subjects, there is some portion of the nerve-mechanism corresponding which can act independently of the rest." Hence I believe that each separate nerve-muscular movement indicates the conditions of activity of some portion of the nerve-mechanism (however diffused that special portion may be); and it follows that lines recording the movements indicate the frequency and coincidence of the activity of portions of the nerve-mechanism corresponding to the movements.

The apparatus* employed consists of :

1. A "motor" made of India-rubber to be attached to the hand, one tube to each finger or moving part (fig. I, A, B, C, &c.). From these, pieces of thin conducting-tube, *a*, *b*, *c*, carry air to a set of recording tambours.

2. A frame supporting the recording tambours and electrical signals (fig. II) :

3. A new "electrical contact-making tambour" (fig. III). It is a modification of the Marey tambour adapted to the purpose of actuating an electrical counter :

4. An electrical counter (fig. IV) :

Now, as to the further details of each piece of the apparatus and its uses. In the motor which is attached to the hand (fig. I), the principle employed is as follows. When a cylindrical tube closed at one end is bent, flattened, or compressed, its capacity is lessened, and therefore air is pressed out of it and driven into the tambour with which it is connected. The needle of the recording tambour is thus moved by the bending of the tube of the motor attached to the finger, the movement of the recording needle corresponds to the movement of the finger and the activity of that part of the central nerve-mechanism which moves the finger. These tubes are moulded for me in soft red rubber by Messrs. Warne & Co.; they are 7½ millimètres in external diameter; one end of the tube, *x*, is pointed and pierced, the other end, *y*, is closed by a moulded cap (fig. I, *y*); and a band moulded to the cap gives the means of fastening the tube to the finger. These tubes are mounted on a "foundation" of sheet red rubber, which is fastened round the hand like a glove (see fig. V). The arrangement represented in fig. VI, *a* and *b*, is convenient in the case of adults, in whom the thickness of the finger makes a considerable drag upon the upper surface of the tube during flexion of the finger. It consists of a pair of moulded caps mounted on a ring back to back; the septum between the two is divided halfway down, and the lower portion is pierced, allowing air to pass from one cap to the other. The band is fastened to the middle of a phalanx, and, the finger-tube being cut at this point, the divided ends are inserted one in each cap. The whole is thus rendered air-tight, and the tension of the upper surface of the tube during flexion of the finger is thus relieved.

The recording tambours mounted in a frame (see fig. II) give tracings upon a revolving cylinder, showing the frequency and coincidence of the various movements. The electrical signals give the means of marking time, indicating events, &c.

"The electrical contact-making tambour" is represented in fig. III. Across the ordinary shell of a Marey's tambour, a main bracket, *a*, *a*, is fixed, to which three smaller ones are screwed, having holes in them to take two arbors. One arbor, *b*, has a beam, *d*, *e*, with a small weight at one end, *e*, and is connected by a short link with the India-rubber head of the tambour. To the other arbor, *c*, a block of ebonite is fixed to insulate two wires, *f*, *g*, with platinum ends, which lie under and nearly touch the beam, *d*, *e*. Each of these wires is connected with terminals, *h* and *i*, by a coil of thin copper wire. A light bent blade-spring is inserted between the ebonite block and the bracket, to resist the motion of the arbor, *c*. The beam, *d*, *e*, has platinum soldered on the part where the platinum ends of the wires are to touch. A terminal, *k*, is fixed

* Towards the expenses of this apparatus a grant was made by the British Medical Association on the recommendation of the Scientific Grants Committee.

Fig. I.

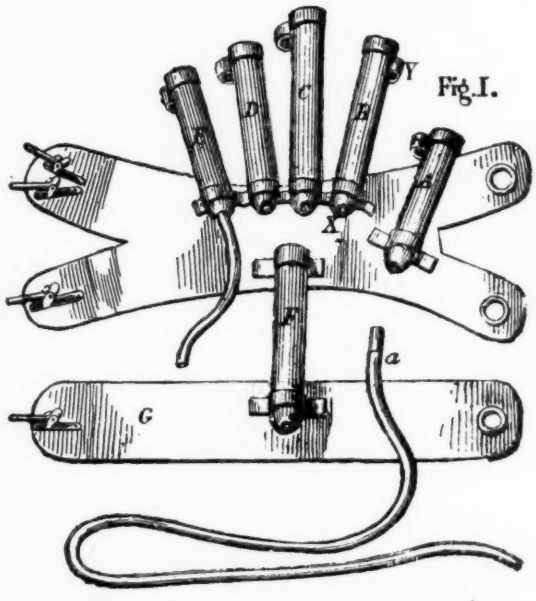


Fig. II

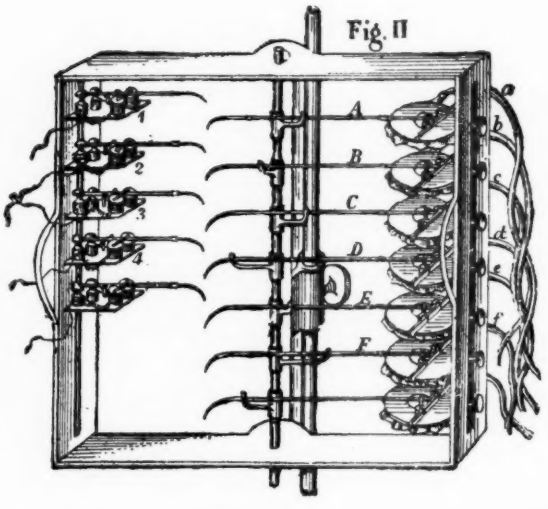


Fig. III.

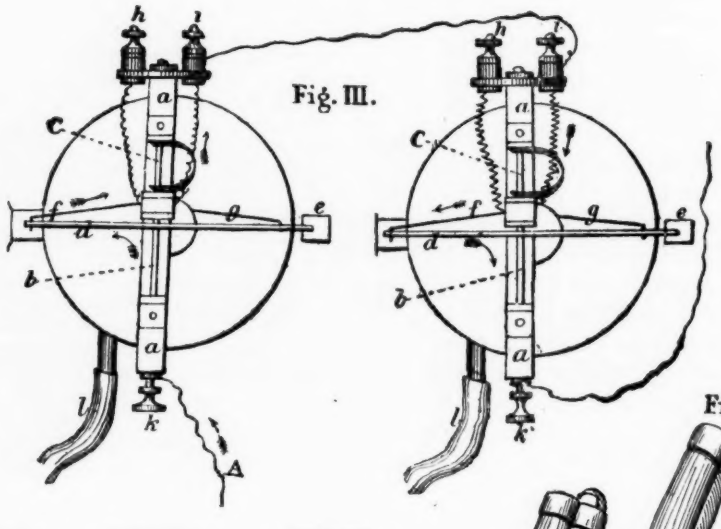


Fig. V.

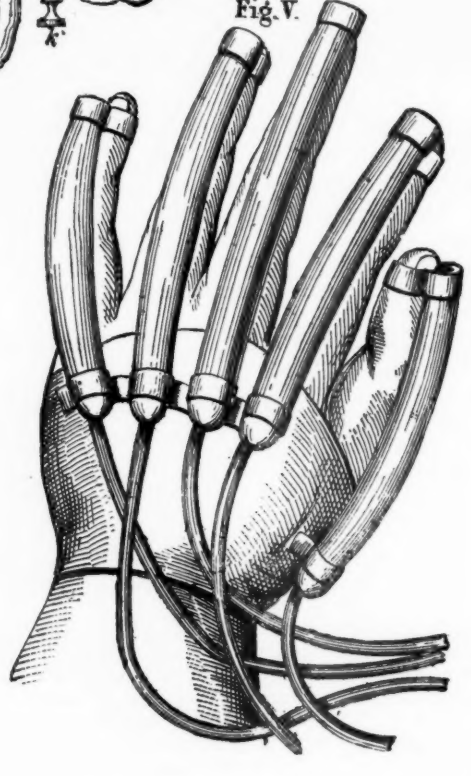
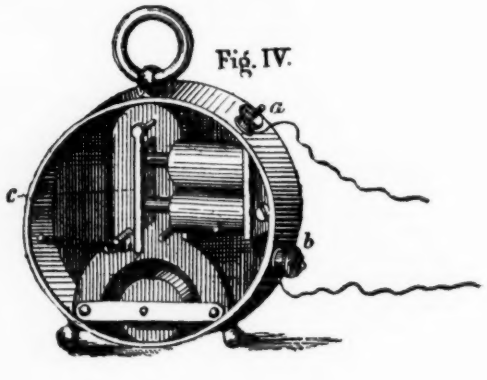


Fig VI.

Fig. IV.



to the main bracket. Increase of air-pressure in the tambour raises one end of the beam, *e*, and depresses the other, *d*, which thus comes in contact with its insulated wire, *f*, completing a circuit through the terminal, *i*; diminished air-pressure allows the beam to move in the opposite direction, completing a circuit through the terminal, *h*.

The instruments are made for me by Mr. W. Groves, 89, Bolsover Street, W. The electrical counter (fig. IV) consists of a clock, to the pendulum of which a small piece of soft iron, *c*, is attached, opposite an electro-magnet, *d*. In use for counting the movements of a finger, the conducting tube (fig. III, *l*) from the finger is attached to the electrical contact-making tambour. One pole of a Leclanché battery of four cells is connected with *k*, and a wire connects *i* with *a* in fig. IV, while *b* is connected with the other pole of the battery. Each flexion of the finger thus allows the escapement of the clock to pass one tooth, and the hands indicate on the dial the number of finger-flexions and the number of times the portion of the nerve-mechanism connected with the finger-flexion has been in activity.

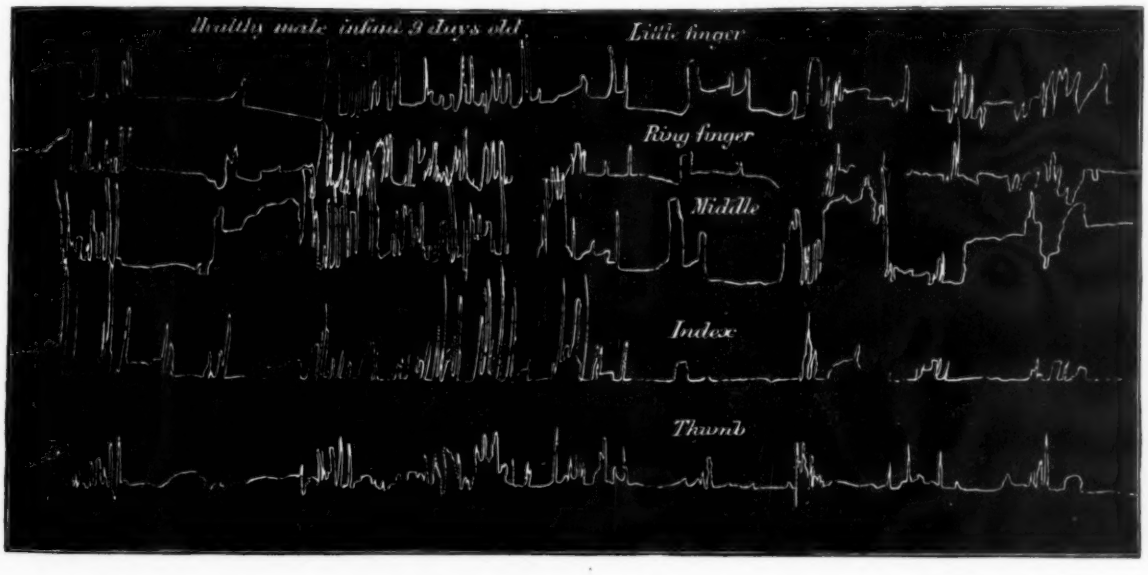
If it be desired to record by figures the number of times that certain special movements (coincidences of movement) have been made we may proceed as follows. Let us consider only flexor movements of the fingers. There are five digits; it is required to count how many times each of the possible combinations of flexion of the five digits occurs. There are 32 such possible combinations of flexion. Let the digits be called A, B, C, D, E; there are 32 possible combinations of these five factors, viz. :—A, B, C, D, E—A, B—A, B, C—A, B, C, D, E, &c. Now, by the following method, it is possible to show, on 32 counters, how many times each of these possible combinations of finger-flexion has occurred in a given length of time.

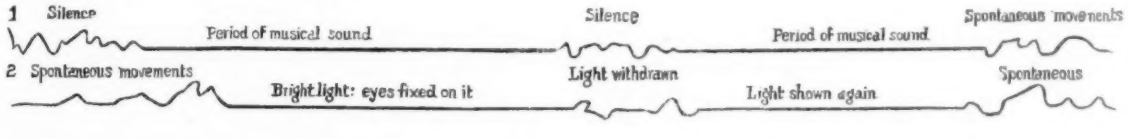
Say it is desired to make a counter enumerate how many times the digits A and B have flexed together. The conducting tubes from the fingers, A, B, are to be connected each with a contact-tambour, then by making the electrical connection between these as indicated in fig. III., and including the counter in the circuit, that counter will be actuated every time that the fingers, A, B, bend together, and will enumerate how many times this special combination of movements has occurred.

As to the problems to be investigated and the uses of these methods.—Among the signs of "nervousness," or the neurotic condition, I have found finger twitching so frequent and characteristic as to form a physical sign of a mobile (exhausted?) condition of the nerve-mechanism. These twitching movements can be recorded and enumerated, and thus coincident facts can be accurately ascertained.

It will be interesting to try to find out in what manner the co-ordination of movements in the growing infant is brought about. A very little observation shows that the apparently purposeless movements of the infant soon become succeeded by co-ordinated movements. Thus, at birth, the movements of the fingers appear quite irregular, there is much uncertainty as to what movements will occur together, and external circumstances often appear to produce but little change in the movements, except when mechanical pressure or irritation sets up movements by reflex action. In infancy spontaneous movements of the fingers are usual while the child is awake (see tracing 1 and 2, taken from fingers of an infant five months old), and spontaneous muscular movements are occurring all over the body; this movement can be arrested by light, and probably also by sound. In studying the mental development of infants we mainly judge of their rapidity and stage of growth by observing the amount, kind, and co-ordination of their movements, *e.g.*, the movements of the head and eyes to a light and sound give some indication of dawning intelligence; these signs are not seen in the earliest stages of growth. Later, in the course of the development of the brain, the finger movements are so co-ordinated as to grasp an object, and still later the two hands act together. At six months of age "the sight of a doll" has some effect in co-ordinating the movements of the hand and fingers, so that they touch and grasp the doll; "the sight of the doll," *i.e.*, the light reflected from the doll, brings about

THIS PLATE REPRESENTS THE MOVEMENTS THAT OCCURRED DURING FIFTEEN MINUTES.





a temporary co-ordination of movements. Perhaps it is in the study of these temporary co-ordinations of movements that we may learn the methods by which permanent co-ordination is brought about. So complicated a problem as the consideration whether the action of light is a factor in building up the co-ordination of the nerve-centres, needs for its investigation accurate logical argument and exact methods and apparatus.

In studying chorea by these methods it has been possible to show that cases differ from one another in the character of the movements; in some cases the movements are singularly simple, in others each gross movement is compounded of several smaller ones. Again, it has been possible to show what causes increase or diminish the amount of movement in a limb; the effects of talking to the patient, keeping her in darkness, making her sit up in bed, &c., in as far as these circumstances affect movement can be investigated. Tracings have been taken showing ankle-clonus, senile tremor, movements of the sternum in health and in chorea, the movements of athetosis, and those due to the sucking of an infant, &c.—the movements of the limbs due to pulsation.

ON CURRENTS OF EMERSION.

By M. KROUCHKOLL.

TWO electrodes of one and the same metal being immersed in a liquid, it is known that if one of them is set in motion within the liquid there is produced a current, the direction of which varies with the nature of the metal and of the liquid in contact. These phenomena have been studied in detail by M. E. Becquerel. We know on the other hand that if one of the electrodes is placed in the liquid and the other is plunged in also, there is produced a current at the moment of immersion. An electric effect of the same kind is obtained at the moment when one of the electrodes is withdrawn from the liquid; there is produced a slight emersion current, and, I believe, that there exists the following simple relation between these three kinds of currents:—"The current produced by immersion is contrary in direction to that produced by movement; the emersion current is in the same direction as the movement current."

Thus, if we plunge a platinum wire, well depolarised into acidulated water, the wire becomes positively electrised at the moment of immersion; it becomes negative if it is moved in the liquid, and negative also if withdrawn from the liquid. The same platinum wire is electrified negatively when plunged into water holding in solution common salt ($\frac{1}{30}$); it becomes positive if moved in the liquid, and also at the moment when withdrawn from the liquid. The same effects are obtained with pure gold.

A silver wire, freshly amalgamated, gives in acidulated water the same results as silver and gold, in direction, but more intensely. In salt water amalgamated silver behaves the same as in acidulated water, contrary to what takes place with gold and platinum.

To perform these experiments we make use of two wires of platinum, gold, or amalgamated silver, which are welded into glass. The two wires plunge into two glasses communicating with each other by means of a syphon. The platinum and gold wires are well washed in nitric acid, and then heated to redness: silver wires are freshly amalgamated. The water, feebly acidulated or salted, is boiled previously. When operating with platinum the acidulated water should be very strong. The two wires are placed in connection with a Lippmann's electrometer. This instrument alone can be employed in experiments of this kind; we thus avoid the polarisation of one of these wires by the other, and its extreme sensibility renders it possible to observe all the successive electric states through which the wire passes from the moment when it is placed in contact with the liquid to when it is drawn out. The bare part of the wire is bent at a right angle with the tube in which it is soldered, so that all its surface may be plunged into the liquid at once and withdrawn in the same manner. There is placed in the circuit a derivation taken from a Daniell, so as to compensate the electric differences which almost always exist between two wires of the same metal, and to ensure at the outset the most perfect electric equilibrium possible.

We may in these experiments replace the air with an insulating liquid, *e.g.*, benzine, and instead of passing from air into salt or acidified water pass into them from benzine. The same effects are obtained.

In the course of these experiments I have remarked that ether, left for some time in contact with water, becomes sufficiently conductive to serve in producing movement currents. I replaced the acidulated water with ether and the insulating medium with a depolarising medium, two zinc wires, covered with an electrolytic deposit of the same metal and amalgamated, plunge the one into a strong solution of sulphate of zinc, and the other into a stratum of ether placed above a stratum of the same solution (sulphate of zinc). We find then that at the moment when it is passed from the sulphate of zinc into the ether the wire is negatively electrified; it becomes positive if moved in the ether, and acquires a positive charge at the moment when it is passed back into the sulphate of zinc; the latter is immediately destroyed by the depolarising effect of the sulphate.

The electromotive force produced by the movement is analogous to the electromotive force of polarisation; it is immediately destroyed in the solutions of the metallic salts with which we operate; when the latter are chemically pure and the solutions concentrated the effects of movement are null. Thus electrolytic zinc does not give a movement current in a somewhat concentrated solution of sulphate of zinc; in a dilute solution of the same salt the effects are very slight, and depolarisation takes place when the metal is left at rest. It is the same with platinum in platinum chloride, copper in a salt of copper, and silver in nitrate of silver.

We may explain these phenomena by the hypothesis of Helmholtz on double electric strata. According to this hypothesis, at the contact of two heterogeneous bodies, there is formed a double stratum, *i.e.*, a system of two electric layers equal, but of opposite signs, each half of the stratum being attached to one of the bodies in contact. At the moment when the wire is plunged into the liquid the double layer is formed; hence a movement of electricity, which is the immersion current. In the same manner at the moment when the liquid quits the surface of the metal this sort of molecular condenser of which the metal and the liquid form the two coatings is destroyed, and its electricities are set free, whence the immersion current.

During the movement of the electrode in the liquid one part, m, of the double stratum, which adheres to the liquid, does not follow the movement of the electrode, and remains on the way, because the liquid is not infinitely conductive. Upon the electrode itself a quantity of fluid, contrary to m, and which was masked by it, is set at liberty. There is hence produced by the movement of the electrode a partial dissociation of the molecular condenser, which constitutes the double stratum, and consequently the difference of potential upon the coatings is increased; hence the movement current. This explanation has been already given by Professor Helmholtz.

THE NEW WIRE GAUGE.

A VERY important step has recently been taken by the Standards Department of the Board of Trade in causing a standard measure for wires and plates to be made and duly verified, and in obtaining its legalisation. The new gauge was approved by an Order in Council, dated August 23rd, 1883, and it will become a Board of Trade standard under the "Weights and Measures Act, 1878," on the 1st March, 1884. As such it will be compulsory, that is to say, no contracts or dealings will be legal, or can be legally enforced, which are specified according to any other gauge. The following circular has also been issued by the department to the several local authorities:—

"After consulting with the various institutions, local authorities, manufacturers, and others practically interested in the use of wire gauges, the Board of Trade have caused a standard measure for wire, &c., to be made and duly verified, which measure has now been approved by Her Majesty in Council, to be, on and after March 1st next, a Board of Trade standard under the Act. I am directed, therefore, by this Board to transmit to you a copy of the sizes of this new standard measure, and to ask for the co-operation of your local authority in giving publicity to it in their district, so that by the common adoption in manufacture and trade of a uniform gauge the annoyance and loss occasioned by the present variety of sizes in use, of which complaint has been made, may no longer arise. I would point out that by the above Act it is provided that all measures in use in trade are to agree with the Board of Trade standards, and that it is the duty of the Inspector of Weights and Measures to see that the Act in this respect is carried out."

The new order has by no means met with universal favour. The iron-masters are said to be very much averse to it; and, according to statements that have been made, consider that, in some of their transactions, as to iron plates particularly, they will be sufferers to the extent of from 10s. to 30s. per ton. Most users of wires and plates, however, will feel thankful for something *fixed*, and it is difficult to understand that anyone should suffer loss on account of the introduction for general use of a single gauge, and one in which the differences in dimensions corresponding to consecutive gauge numbers proceed according to a law having some approach to regularity.

There are, I believe, at the present time some 14 different English wire and plate gauges in more or less common use. Thus we have the Birmingham wire gauge, the Birmingham plate gauge, the Lancashire gauge, the music wire gauge. Zinc is measured and specified by the zinc gauge, and utter want of uniformity prevails. As to the Birmingham wire gauge itself we are dependent on private makers of the well-known notched gauge plates for reproduction of the standard, and it is more than doubtful whether the gauge plates of different makers agree even moderately well among themselves. The equivalents in decimals of an inch and of a centimetre of the numbers of the B. W. G. have been given by Sir J. Whitworth, Holtzapfel, and others, and constitute the tables of "decimal equivalents" quoted in engineering pocket books. Any one who will be at the trouble of taking the differences between the equivalent numbers corresponding to succesive numbers of the gauge will be struck by the want of any apparent law connecting the progressive dimensions. The numbers, again, of the Birmingham wire gauge and of the Birmingham plate gauge run in opposite directions, and the whole system of these measurements is at the present moment "well adapted for producing confusion."

With the newly authorised gauge we gain at least three important points.

First. A standard gauge, authorised, and easy of reference with the aid of the several instruments now in use for measuring wires and plates; for example, by means of the screw micrometer gauges now made so perfect in England and so excellent and so inexpensive in Germany and in America.

Second. The compulsory use of the *same* gauge for the measurement of the thickness of copper, brass, iron, tin-plate, lead, zinc, &c., and of wires and plates of the various metals,—the same gauge, in fact, whenever the thickness of any wire or plate is specified. It is, of course, open to contracting parties still to sell and buy at so many pounds to the linear foot or to the square foot, as is done now in the case of sheet lead, and as it is said will be done by the iron-masters in the case of iron plates after the introduction of the new gauge.

Thirdly. As to the gauge itself, we have a very convenient series of numbers following at least a rational law. It may be doubted whether everything now gained would not have been gained equally, in addition to some further considerable advantages, if the decimal gauge in thousandths of an inch, recommended by Sir J. Whitworth, had been legalised and made the Board of Trade standard. The new gauge consists simply of a selected series of dimensions in thousandths of an inch with specifying gauge numbers attached to them from 1 to 50 and from 1 back to 7 zeros. All these would have been included in the decimal gauge had it been taken as the standard. The following table gives the descriptive numbers of the new wire gauge with the decimal equivalents, and with the differences in thousandths of an inch :—

Descriptive Number.	Equivalents in Parts of an Inch.	Differences.	Descriptive Number.	Equivalents in Parts of an Inch.	Differences.
No.	Inch.		No.	Inch.	
0,000,000	0·500	36	23	0·024	2
000,000	·464	32	24	·022	2
00,000	·432	32	25	·020	2
0,000	·400	28	26	·018	1·6
000	·372	24	27	·0164	1·6
00	·348	24	28	·0148	1·2
0	·324	24	29	·0136	1·2
1	·300	24	30	·0124	·8
2	·276	24	31	·0116	·8
3	·252	20	32	·0108	·8
4	·232	20	33	·0100	·8
5	·212	20	34	·0092	·8
6	·192	16	35	·0084	·8
7	·176	16	36	·0076	·8
8	·160	16	37	·0068	·8
9	·144	16	38	·0060	·8
10	·128	12	39	·0052	·4
11	·116	12	40	·0048	·4
12	·104	12	41	·0044	·4
13	0·092	12	42	·0040	·4
14	·080	8	43	·0036	·4
15	·072	8	44	·0032	·4
16	·064	8	45	·0028	·4
17	·056	8	46	·0024	·4
18	·048	8	47	·0020	·4
19	·040	4	48	·0016	·4
20	·036	4	49	·0012	·2
21	·032	4	50	0·0010	
22	·028	4			

Electric engineers are now habitually making use of the metrical system of weights and measures; and, seeing that all our electric and magnetic units are defined in connection with the C.G.S. system, and our newest and best instruments graduated to correspond with this system, the use of it may be expected to become more and more common, and finally, it may be hoped, universal. In the following table, in column 3, the equivalent dimensions in thousandths of a centimetre are given for the numbers of the new gauge. Column 4 gives the cross sectional area of round wires corresponding to the several numbers, and will be found useful for many purposes; for example, for showing at a glance the wire (copper) necessary for

carrying a given current for incandescent lighting, according to Sir W. Thomson's rule of not less than 1 sq. centimetre per 50 amperes. Columns 5 and 6 give the resistance and the conductivity of pure soft copper wire at 15° C. (59° Fah.), an ordinary temperature of the air. The best "conductivity" copper never gives more than 98 per cent. of the conductivity represented in the table, and ordinary good wire may give 95 per cent. or so. Thus 4 or 5 per cent. must commonly be added to the resistance of the copper wire given in the table, and 4 or 5 per cent. subtracted from the conductivity there given. It must be remembered, however, that much of the copper wire of commerce is very far below the standard of 95 per cent. conductivity. The last column gives the weight of wire calculated for the density of 8·90, that of water at maximum density being called unity. This is the number commonly taken as representing the specific gravity of copper wire. It seems doubtful, however, whether a somewhat higher number would not represent better the specific gravity of ordinary copper wire. The number 8·95 is sometimes quoted. This, which is probably too high, would cause one-half per cent. to be added to the weights given in the table.

DIMENSIONS OF CROSS SECTION OF ROUND WIRE, WITH RESISTANCE, CONDUCTIVITY, AND WEIGHT OF PURE COPPER WIRE.

No. on New Board of Trade wire gauge.	Diameter.		Area of cross section.	Pure Copper Wire (soft drawn).		Weight of wire density 8·90 (copper).
	Ins.	Cms.	Sq. Cms.	Resistance Ohms per metre.	Conductivity Metres per Ohm.	Grammes per metre.
7/0	·500	1·270	1·267	·000135	7402·1	1127·4
6/0	·464	1·178	1·090	·000157	6370	970·2
5/0	·432	1·097	·945	·000181	5521	840·8
4/0	·400	1·016	·811	·000211	4736	721·3
3/0	·372	·945	·701	·000244	4098	624·2
2/0	·348	·884	·613	·000279	3584	545·9
0	·324	·823	·532	·000322	3107	473·2
1	·300	·762	·456	·000375	2666	406·1
2	·276	·701	·386	·000444	2253	343·2
3	·252	·640	·322	·000532	1881	286·5
4	·232	·589	·273	·000628	1592	242·5
5	·212	·538	·228	·000751	1331	202·7
6	·192	·488	·187	·000916	1092	166·3
7	·176	·447	·157	·00109	917·8	139·8
8	·160	·406	·130	·00132	757·2	115·3
9	·144	·366	·105	·00163	614·9	93·7
10	·128	·325	·0829	·00206	484·6	73·8
11	·116	·295	·0682	·00251	398·3	60·7
12	·104	·264	·0548	·00312	320·3	48·8
13	·092	·234	·0429	·00398	250·6	38·2
14	·080	·203	·0324	·00528	189·5	28·9
15	·072	·183	·0263	·00651	153·5	23·4
16	·064	·163	·0208	·00824	121·3	18·5
17	·056	·142	·0159	·0108	92·7	14·1
18	·048	·122	·0117	·0147	68·2	10·4
19	·040	·1016	·00811	·0211	47·4	7·19
20	·036	·0914	·00657	·0260	38·4	5·84
21	·032	·0813	·00519	·0330	30·3	4·62
22	·028	·0711	·00397	·0431	23·2	3·54
23	·024	·0610	·00292	·0587	17·05	2·60
24	·022	·0559	·00245	·0698	14·32	2·18
25	·020	·0508	·00203	·0845	11·84	1·80
26	·018	·0457	·00164	·104	9·59	1·46
27	·0164	·0417	·00136	·125	7·97	1·21
28	·0148	·0376	·00111	·154	6·48	0·988
29	·0136	·0345	·000937	·183	5·46	·834
30	·0124	·0315	·000779	·220	4·55	·693
31	·0116	·0295	·000682	·251	3·98	·607
32	·0108	·0274	·000591	·290	3·45	·526
33	·0100	·0254	·000507	·338	2·96	·451
34	·0092	·0234	·000429	·398	2·51	·382
35	·0084	·0213	·000358	·478	2·09	·318
36	·0076	·0193	·000293	·585	1·71	·260
37	·0068	·0173	·000234	·730	1·37	·208
38	·0060	·0152	·000182	·943	1·06	·162
39	·0052	·0132	·000137	1·248	·801	·122
40	·0048	·0122	·000117	1·466	·682	·1038
41	·0044	·0112	·0000982	1·742	·574	·0874
42	·0040	·0102	·0000811	2·109	·474	·0721
43	·0036	·00914	·0000656	2·611	·383	·0584
44	·0032	·00813	·0000519	3·300	·303	·0462
45	·0028	·00711	·0000397	4·310	·232	·0353
46	·0024	·00610	·0000292	5·848	·171	·0260
47	·0020	·00508	·0000203	8·475	·118	·0180
48	·0016	·00406	·0000129	13·23	·076	·0115
49	·0012	·00305	·00000730	23·42	·043	·00650
50	·0010	·00254	·00000507	33·78	·030	·00451

J. T. BOTTOMLEY.

SILVANUS THOMPSON'S TELEPHONIC APPARATUS.

PROFESSOR SILVANUS THOMPSON has recently patented some new forms of telephonic apparatus which are described as being modifications in, and additions to, telephones of the kind invented by Philipp Reis, and described in the years 1862 and 1863 in the journal of the Austro-German *Telegraph Union* and in Dingler's *Polytechnic Journal;* and also in 1866 in Kuhn's "Handbook of Applied Electricity."

The inventor states that, by various details of construction and arrangement, he converts instruments which are practically useless for the present applications of telephony into highly useful and serviceable apparatus.

In the original apparatus of Reis, the person using the same, spoke into a tin cone closed at one end by a tympanum of collodion, and the vibrations of the voice, taken up by the tympanum, were caused to act upon a small curved lever of which the material was not prescribed; it must, says Prof. Thompson, have been a substance that will conduct electricity, but it was to be as light as possible, and the plain inference from the description given is that it should be non-metallic. This lever rested with one end against the tympanum, and at the other end was caused by means of a delicate spring to press against a contact piece mounted upon a vertical spring, and adjusted to the requisite degree of contact by a screw. The function of this lever was to open or close the circuit to a greater or less degree, according to the vibrations imparted to it, and, by thus varying the contact between the parts, to throw the current into corresponding vibrations; the object being to magnetize and demagnetize an electro-magnet at the receiving end of the line, so as to make it increase and decrease in the force with which it attracted its armature which was consequently thrown into vibrations corresponding to the original vibrations. The aforesaid lever was made with its arms of unequal length, thereby sacrificing the range of its motion in order to obtain a greater range of force or pressure between the contact parts. The whole instrument was mounted on a stand.

Prof. Thompson's improvements in the transmitters referred to are illustrated by figs. 1 and 2.

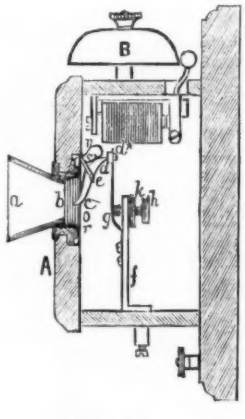


FIG. 1.

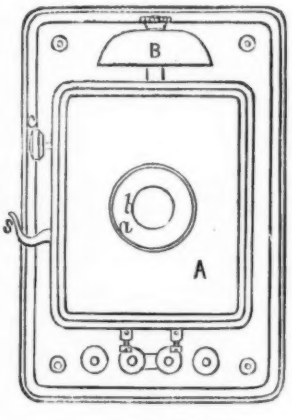


FIG. 2.

The box, A, can be fixed to a wall, leaving only the mouth-piece exposed; this mouth-piece is a hollow metal cone, *a*, *b*, so arranged that it may be screwed to the box from the outside. The frame or ring, *r*, which holds the tympanum, *o*, is affixed by screws or clamps to the socket which holds the mouth-piece as shown. The inventor finds that amongst tympanums of collodion variously prepared those which are made of the preparation of collodion known as celluloid are the most satisfactory, and are least liable to become flaccid with the moisture of the breath.

For making the curved lever, *c*, *d*, in order that it may be as light as possible, the inventor generally uses either aluminium or artificial *coke-carbon*, these substances being the lightest of good conductors available for the purpose. The artificial *coke-carbon* is however preferred. The action of this lever is found to be more certain when a pin or pivot is inserted at *e*, to attach it to the support, *s*, which is preferably formed to receive the lever.

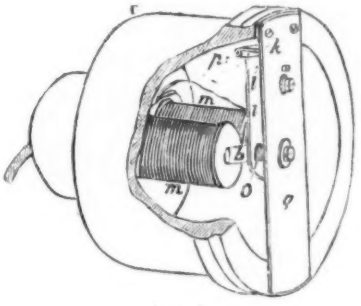


FIG. 3.

For the contact-piece touching the lever at, *d*, the inventor employs a small stud, d^*, of silver, nickel, native amalgam ore, or other good conductor of electricity, or, in some cases, one of the good conducting kinds of carbon, such as pure dense graphite; the stud, d^*, is mounted on a slender vertical spring, *g*. The spring, *g*, is carried upon a metallic support, *f*, and its pressure against the lever, *c*, *d*, is regulated by an adjusting screw, *h*, provided with a locking-nut, *k*.

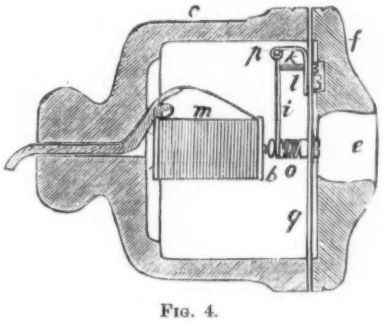


FIG. 4.

Figs. 3, 4 and 5 show one form or modification of Prof. Thompson's receiver.

The original apparatus of Reis consisted of an electro-magnet laid flat upon a sounding board or sounding box, and having in front of its poles an armature consisting

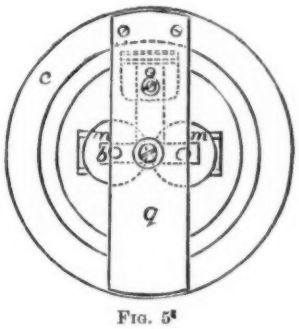


FIG. 5*

of an iron bar of oval section attached to the end of a thin flat or plank-like lever, hung in the manner of a pendulum from a pivot or hinge, but restrained by a spring and an adjusting screw from swinging freely like a pendulum. According to Prof. Thompson's invention this arrangement is modified for the purpose of getting a better acoustic effect, and a very con-

venient form of instrument, as follows, viz. :—In order that the vibrating plank-formed lever may affect the ear more satisfactorily, the whole of the parts are made smaller and more compact than in the original instrument of Reis, so that the instrument can be put directly to the ear, the whole being enclosed within a case, *c*, suitable to be held in the hand. This case, *c*, is a circular box of wood or other material closed at one end, open at the other, and provided at its wide end with a cover to serve as an ear-piece or embouchure.

In the form shown in figs. 3, 4 and 5, an electromagnet, *m*, is placed with its poles pointing toward the mouth of the case. In front of these poles, but not touching them, the armature, *b* (which is a bar or tube of iron of oval section), is fixed on or near one end of the thin broad lever, *i*, which should be made either of wood or of brass or zinc. This lever is pivotted at *p*, to a support, *k*, like a pendulum. The motion of the lever, *i*, is controlled by the spiral spring, *o*, and the adjusting screw, *l*. The latter passes through the support, *k*, and the cross-bar, *q*, which may be of wood, brass, zinc, slate or mica, and is screwed to the case at one of its ends. Another screw passing through the cross-bar, *q*, is screwed into the end of spiral spring, *o*. On the end of the box or case containing the parts above enumerated there is screwed a cover, *f*, of wood or other suitable material perforated with an aperture, *e*, as shown in fig. 4. This aperture serves as an embouchure for the sounds emitted by the apparatus.

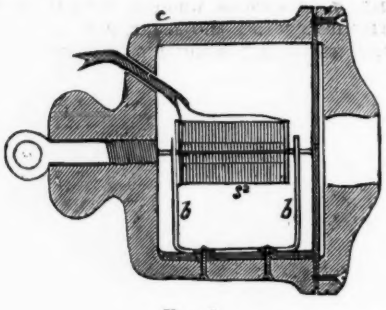


FIG. 6.

Fig. 6 shows another form of receiving instrument, which, like the preceding, is a modification of one of Philipp Reis's receivers described in the publications named above, and particularly at p. 1,020 of "Kuhn's Handbook." That instrument, in its original form, consisted of a steel needle or wire surrounded by a coil of wire, and resting on two wooden supports or bridges

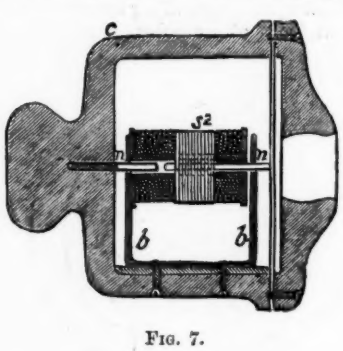


FIG. 7.

over a sounding board of pine wood. Prof. Thompson now modifies the said instrument in the following manner :—He mounts the spiral, s^2, on its bridges, *b*, *b*, these parts being made of such dimensions as will permit their inclosure within a case, *c*, of convenient size and shape, in which he arranges them as shown. He places a thin sounding board, of pine wood or other material capable of vibrating, against the end of the needle, the same being clipped between the case and the cover. The back end of the needle buts against an iron or steel screw ; this screw serves at the same time to hang up the instrument with. The inventor states that he has further discovered that, since the vibrations of the steel or iron needle are due to mutual attractions and repulsions between the molecules, which, occurring simultaneously, set up attractions and repulsions and vibrations in the mass as a whole, their power is increased by giving to the molecules of different parts of the needle a greater play than is permitted by the mere elasticity of the needle itself. Accordingly he divides the needle into two parts, each being mounted on its own bridge or support, as shown in fig. 7, wherein the two parts of the needle are marked *n*, *n*, the bridges, *b*, *b*, and the spiral s^2.

GRANOLITHIC CONDUITS FOR ELECTRICAL CONDUCTORS.

A CORRESPONDENT furnishes us with the following particulars of Berry and Stuart's granolithic conduits for electrical conductors, which we noticed in a recent issue of the ELECTRICAL REVIEW.

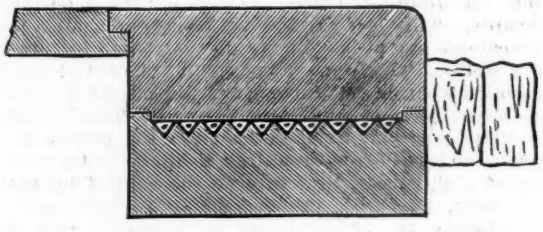


FIG. 1.

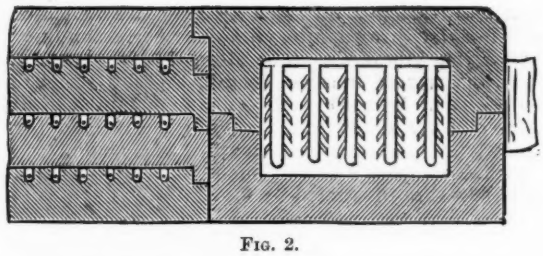


FIG. 2.

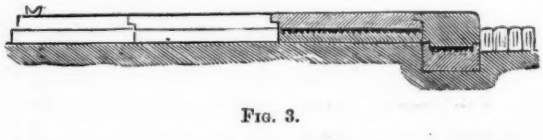


FIG. 3.

Figs. 1, 2 and 3 show the arrangements for bare copper or iron wires surrounded by granolithic or other insulating substance.

Figs. 4, 5, 6 and 7 illustrate the conduits for one or more wires coated with gutta-percha or other insulator.

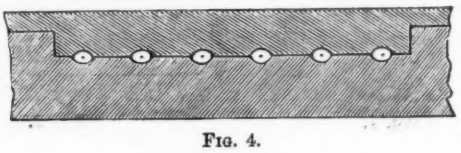


FIG. 4.

FIG. 5.

The channels are made perfectly smooth and are of great durability. They can be made of any capacity, to any pattern, and of strength sufficient to meet the requirements of the heaviest carriage-way traffic. The new

system is, however, best adapted for pavements, and it was under the title of Pavements that the patent, No. 1894, was secured.

It is contended that the wires will not adhere to the granolithic conduits as they do to the iron tubes at present used, and that consequently the labour of drawing in and out wires for renewal or other purposes will be greatly lessened. The lines may be sectionally laid, so that should it at any time be necessary to gain access to the wires at a point between two flush boxes, the section required may be opened and closed at a very small cost, and that, too, without in any way impairing the pristine condition of the line.

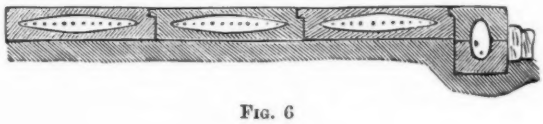


FIG. 6

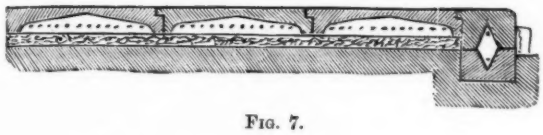


FIG. 7.

Granolithic is said to be a non-conductor of electricity, and as the conduits can be made of any size it is argued that there is no valid reason why telegraph, telephone and electric lighting wires should not be laid under one pavement, and further, that as granolithic is finding much favour both at home and abroad for paving purposes, the tops of the conduits might form the street surface, which would be advantageous to the electrical folks and would give least public inconvenience. It is said to be much cheaper than the present system of cast-iron pipes.

CABLES UPON CABLES.

A WRITER in *Le Figaro* of October 25th says :—

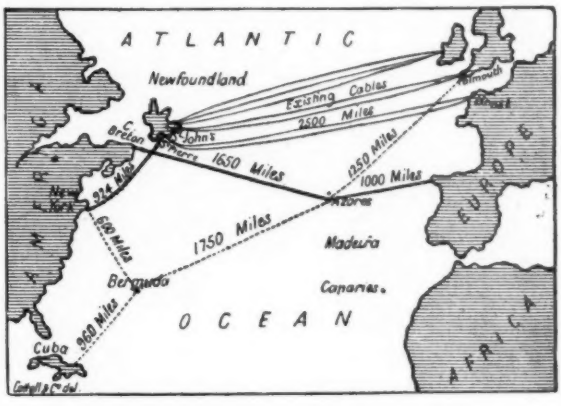
I related, the other day, a conversation with Mr. Gordon Bennett, and although the project of Messrs. Bennett and Mackay was, it seemed, already known to their compatriots, the idea of their cable was greatly approved of in France, because of the reduction in the rates which they promised to the public.

But this is more curious. M. de Braam, a Dutch engineer, has just obtained from the Portuguese Government the concession for a submarine line landing at the Azores and passing from thence to the coast of America.

It is proved that the more we diminish the length of a cable the less this cable costs to establish, and the more its properties of transmission increase. Long distance incurs loss of current, &c. . . . .

M. de Braam, whom I saw yesterday at the house of M. Behrens, one of his English friends who is engaged in this business with him, clearly explained his scheme to me.

"My project is simple : it is enough to look at the map," added he, drawing that which is shown in the attached map, "to understand its economy. Upon short cables great rapidity of transmission is favoured by the diminution of the phenomena of induction and retardation. Thus, whilst the average transmission upon actual cables* does not exceed eight to 10 words per minute, it will reach by the Azores cable 25 words per minute. The line composed of short cables costing much less than 35 millions francs to establish (I have estimates which do not exceed 10 millions for the two sections of my line), we should not require to charge a tariff as high as the other companies, and we could defy competition by lowering the tariff 50 centimes per word to begin with. The profusion of telegrams at this price would certainly indemnify our expenses. The consequence comes by itself : the others not being able to lower the tariff to this reduced price, the telegraphic movement between the two hemispheres would necessarily concentrate itself upon the Azores cable.



"Without considering, what will be seen at a glance, all the interest which France will have in laying the Azores cable, which will be followed by a second to Bermuda, a third to Cuba, and finally to Panama, I would remark that, for Spain, the establishment of this line will have the interest of a national enterprise, for it will give it direct communication with Havana, without remaining dependent on the northern countries.

"The English naval station at Bermuda being deprived of telegraphic communication with the continents, England cannot but favour the installation of a cable to Bermuda. (See the dotted line in the attached map.)

"For the French Antilles and Panama the advantages are also indisputable.

"As for the United States telegraphy going from the Azores to Torbay, or from Bermuda to New York, it will cost in both cases infinitely less to the Americans than what they pay with the existing cables."

M. de Braam has the concession and the monopoly of landing at the Azores for 20 years.

The question of seeking among the Atlantic islands for resting and relay points for the submarine lines has often been raised, but hitherto unsuccessfully.

Mr. Bennett hopes to lower the price of each word to 1 franc 25 centimes.

M. de Braam promises us to open his line with a tariff of 50 centimes per word.

Noble emulation ! in which commerce can but rejoice, and which must be encouraged in the interest of all.

It is the solution of the problem of cheap telegraphy between the two hemispheres.

* M. de Braam evidently meant Atlantic cables.—EDS. ELEC. REV.

GENERAL RULES FOR THE INSTALLATION OF INCANDESCENCE ELECTRIC LIGHTING.

(*Continued from page* 327.)

I HAVE taken, to calculate the values of r, the true resistances of the lamp, for the emission of different amounts of light, given by experiment, and not the half of the resistance hot ; the error in r did not exceed 4 or 5 per cent. of the true value.

If in the formula which we used to determine i, we take the square root of r, we have

$$i = \frac{I}{\sqrt{r}} = \sqrt[6]{\frac{L}{\alpha}}$$

Taking for r, values representing the half of the resistance cold of the lamp, we see that the error com-

mitted in the determination of i would not reach 2 or 2·25 per cent. of the absolute value of the true current strength.

TABLE II.

LAMPS.	α_1	$K = \sqrt[3]{\frac{\alpha_1}{\alpha}}$	Resistances (hot).	OBSERVERS.
Edison 7. B...	0·000136 (*)	1	60	Jamieson.
„ B. E. L.	0·000116	0·948	73	„
„ B, No. 1	0·001049	0·917	66	Munich Committee.
„ A, No. 1	0·000049	0·707	158	„
„ A, No. 2	0·0000305	0·607	136	„
„ A	0·000079	0·834	137	Exhibition 1881.
„ C	0·000075	0·820	130	„
Maxim	0·000066	0·787	38	Jamieson.
„ L, No. 1	0·0000248	0·568	46	Munich Committee.
„ L, No. 2	0·0000312	0·613	45	„
„ A	0·0000336	0·627	41	Exhibition 1881.
„ B	0·0000337	0·628	40	„
Swan, No. 1 ...	0·000073	0·813	31	Jamieson.
„ N. VI. V. dép. ...	0·000042	0·676	34	„
Small Swan, L, No. 1 ...	0·0001024	0·911	30	Munich Committee.
Large Swan, L, No. 5 ...	0·0000114	0·438	82	„
Swan A.....	0·000050	0·717	33	Exhibition 1881.
„ B.....	0·000039	0·660	32	„
Lane-Fox.....	0·000098	0·896	95	Jamieson.
„ A ...	0·000049	0·711	27	Exhibition 1881.
„ B ...	0·0000486	0·710	27	„
Siemens, No. 1	0·0000233	0·556	100	Munich Committee.
„ No. 2	0·0000195	0·523	105	„
„ No. 3	0·0000268	0·582	107	„
Small Müller No. 5	0·0000286	0·595	60	„
Small Müller No. 6	0·0000228	0·549	56	„
Müller average, No. 1.	0·000071	0·374	54	„
Müller average, No. 2.	0·000092	0·407	65	„
Müller large, No. 1	0·0000025	0·264	68	„
Cruto	0·0000325	0·621	8	„

THE DETERMINATION OF THE NUMBER OF LAMPS IN DERIVATION.

Knowing the current strength, i, which traverses the lamp for a given luminous intensity, a very simple calculation will give us the number of lamps which must be placed in derivation for a total current, I, furnished by the machine.

Let N be the number of lamps:

$$N = \frac{I}{i} \qquad (3.)$$

THE CO-EFFICIENT OF RENDERING OF LAMPS.

Before passing to the problems which will serve for arrriving at the speed of the machine, it will be interesting to determine what may be called the co-efficient of rendering of a lamp in relation to the lamp which gives the best luminous rendering (Edison 7 B—Jamieson).

If we consider several lamps, A, A′, A″, we shall have for the same luminous intensity

$$L = \alpha\ (a)^3 = \alpha'\ (a')^3 = \alpha''\ (a'')^3$$

We give to α and a the values belonging to the Edison lamp 7 B. The electrical work, expressed in volt-ampères, taking for unity that of the Edison lamp, will be for each of the lamps, A′, A″, established by the equations

$$\frac{a'}{a} = \sqrt[3]{\frac{\alpha'}{\alpha}} = T'\ i' \qquad \frac{a''}{a} = \sqrt[3]{\frac{\alpha}{\alpha''}} = T''\ i''$$

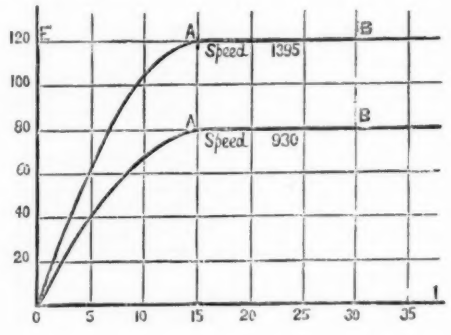
But the luminous rendering is inversely proportional to the quantity of work expended for the lamp, and the co-efficient of rendering of each of the lamps will be given by the formulæ

$$K' = \sqrt[3]{\frac{\alpha'}{\alpha}} \qquad K'' = \sqrt[3]{\frac{\alpha''}{\alpha}}$$

The third column of table 2 gives the co-efficients of rendering for 30 lamps of different types.

The Determination of the Speed of the Dynamo-Electric Machine.

The solution of this problem is given directly by the "characteristic curve":—



Taking for the abscissæ the currents furnished by a machine, at a given speed, and for ordinates the electromotive forces corresponding to each current strength, we may trace the curve (*see* fig.).

The electromotive forces are determined by the product of the total resistance, multiplied by the current strength of the circuit

$$E = R\ I \qquad (4.)$$

If we determine the "characteristic" of a machine at several speeds we remark that, for a given current, the electromotive forces are proportional to the speeds.

This law is expressed by the formula

$$\frac{V_1}{V} = \frac{E_1}{E}$$

In the special case of an installation of incandescence lamps, if we know I, the total current strength of the circuit, we have only to determine the total resistance, R, to calculate the electromotive force, E, which the machine should furnish; according to the formula (4)

$$E_1 = R_1\ I$$

The speed of the machine will be obtained from the equation (5) and calculated by means of the formula

$$V_1 = V\,\frac{E_1}{E}$$

in which E represents the electromotive force obtained from the "characteristic" traced at a speed, V, for a current strength, I.

The resistance, R, consists, in the case under consideration, of

ρ the internal resistance of the machine;
ρ' the resistance of the conducting wire;
ρ'' the resistance of the whole of the lamps when hot.

TABLE III.

ELECTROMOTIVE FORCES AT A SPEED OF 100 REVOLUTIONS.

MACHINES.	Internal Resistances.	Current strength at A.	Electromotive forces at A—B.
Gramme *a*	0·097	40	11
Gramme A, *renforcée* ...	0·359	35	54
Gramme A, workshop type	1·020	15	86
Siemens D_5	0·640	20	38
„ D_6	1·289	15	55
„ D_2	0·564	20	94
„ D_1	0·470	35	160
„ D_0	0·540	45	235

(*) For Edison's lamp, 7 B α_1 becomes α.

ρ is known; ρ' may be determined by calculation or directly measured; we may obtain ρ'' from the resistance of one lamp hot, knowing the number, N, of lamps placed in derivation in a series (formula 3) and he number, n, of series.

The incandescence lamps will have a resistance given by the formula

$$\rho'' = n \frac{r}{N}$$

For r given, we see that ρ'' varies proportionally to the number of series and in an inverse ratio to the number of lamps put in derivation in each series. We shall have, therefore, for the value of the total resistance, R_1.

$$R_1 = (\rho + \rho') + n \frac{r}{N}$$

$(\rho + \rho')$ are known, once for all, and do not vary.

The "characteristics" which we shall give as an example are those of the A Gramme machine, workshop type. We notice that after 15 ampères the electromotive force does not increase. Whatever the speed at which we find the "characteristic", the curve, after point A corresponding to 15 ampères, will be parallel to the axis of x; from this point the magnetic field is saturated and we have

$$E = R\,I = R'\,I' = R''\,I''$$

The resistances to be overcome are inversely proportional to the strengths of the current for a given electromotive force.

In practice we generally employ current strengths corresponding to the part, A, B, of the "characteristic." A, B is only limited by the heating which the machine suffers for too high currents.

If we cannot determine the "characteristic," it will be enough to know the intensity, I, after which the electromotive force, E, for a given speed no longer increases, and we must not employ an intensity lower than I.

If E is fixed at 1,000 revolutions for each type of machine, the general formula for the determination of the speed becomes

$$V_1 = 1000 \frac{E_1}{E}$$

In table 3 we give the electromotive force, for a speed of 1,000 revolutions of some generally used machines. The third column indicates the strengths after which the electromotive force no longer varies.

Practically, we give the machine a rather higher speed than that given by the calculations.

We place in the circuit a rheostat or resistance commutator.

This apparatus will serve to regulate the total strength of the current indicated by a galvanoscope during the whole period of lighting; a simple movement of the commutator key will restore the current to its normal strength.

REACTION OF THE COPPER-ZINC COUPLE ON NITRIC OXIDE.*

By J. H. GLADSTONE, F.R.S., and ALFRED TRIBE, F.C.S.

IT has been pointed out by Graham and others that hydrogen in the occluded condition is much more chemically active than when in its ordinary gaseous state.

We have already suggested that hydrogen, immediately after its liberation from water by the action of the copper-zinc couple, becomes more or less completely occluded by the spongy copper which constitutes the negative element, and that the reducing property of the couple arises from the presence of hydrogen in the occluded state. In continuation of our work on this subject we made the following experiments on the action of the couple in the presence of water on nitric oxide:—

(i.) 30 litres of the gas were passed in 7 hours over 2,000 square centimetres of zinc foil coated with 18 grams of black spongy copper, the couple being wet with water. 0·037 gram of ammonia was produced.

(ii.) In another experiment 26 litres of nitric oxide were passed in about 5 hours over 2,500 square centimetres of zinc foil, coated with 20 grams of copper; 0·05 gram of ammonia was produced.

The question was now suggested, does free nitrogen also hydrogenise to ammonia under similar circumstances? Several prolonged experiments were made, but no evidence was obtained of the formation of ammonia.

* Journal of the Chemical Society.

ON THE REDUCING ACTION OF SPONGY LEAD.*

By J. H. GLADSTONE, F.R.S., and ALFRED TRIBE, F.C.S.

IN our recent experiments upon lead and lead peroxide batteries we were desirous of ascertaining whether spongy lead, perfectly free from hydrogen, was capable of reducing such salts as nitrate and chlorate of potassium. For this purpose spongy lead was prepared by precipitating the metal from the acetate by means of zinc, taking care that the salt was always in excess. It is difficult to imagine that lead prepared in this way should contain any occluded hydrogen. Nevertheless, it somewhat quickly reduced nitrate to nitrite of potassium. This action was found to be accelerated by heat, and to be retarded by the presence of sulphuric acid. A minute quantity of ammonia was also produced, especially when sulphuric acid was present or a high temperature employed.

In each of the experiments, the results of which are set out in the following table, 50 grams of spongy lead were employed, and 200 c.c. of a 5 per cent. solution of nitre. In experiments III and IV the nitre solution contained 1 per cent. of H_2SO_4.

Experiment.	Temperature.	Time.	Percentages (grams).	
			KNO_3.	NH_3.
I.	13°	1 hour	0·38	0·00005
,, ...	,,	24 hours	2·06	0·00015
,, ...	,,	48 ,,	2·43	0·00024
II.	50	1 ,,	0·74	0·002
III.	13	1 ,,	0·05	0·006
IV.	50	1 ,,	0·13	0·003

Spongy lead has no action on an aqueous solution of potassium chlorate, but in presence of 1 per cent. of H_2SO_4 its reduction to chloride takes place slowly at ordinary temperatures.

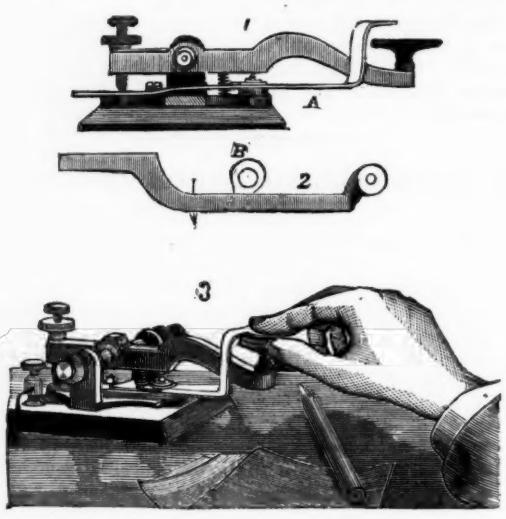
The increased chemical activity of substances, when in a finely divided condition, is to be generally accounted for by the greater surface exposed, and as a rule the actions brought about are similar in kind, but differ in degree. Spongy lead appears to form no exception. Ordinary lead filings were found to reduce nitre, &c., but very much more slowly.

* Journal of the Chemical Society.

The New York Electrical Society.—The meetings of the New York Electrical Society were resumed Friday evening, October 5th, after an adjournment through the summer months. President Small made a few appropriate remarks on the death of Mr. C. F. Varley, the eminent English electrician, and appointed a committee to draft suitable resolutions thereon. The subject of the evening's lecture was "The Use of the Electric Light in Artistic Photography, Illustrated by Diagrams and Specimens of the Results," by Prof. P. H. Van der Weyde.

AUTOMATIC CIRCUIT CLOSER.

THIS device, which we notice in the *Scientific American*, is designed to automatically close the circuit of telegraph keys, and may be applied to either old or new keys or to keys of various sizes. A spring lever, A, fig. 1, presses upward, either normally or aided by a spring placed beneath it, against a pro-



jection, B, from the side of the key. Fig. 2 is a plan view of the lever and projection. One end of this lever is so bent that its extremity rests about three-eights of an inch above the finger button of the key. The rear end of the lever is secured to the frame by a screw. When operating, the forefinger is placed on the end of the lever, A, which is pressed down until it rests on the button of the key, which is grasped by the thumb and middle finger. When the lever is released, it presses against the projection and automatically closes the circuit. The device is very convenient, as the operator need not take the trouble to close the circuit every time he stops telegraphing, as it can never be left open. The invention has been patented by Mr. Samuel J. Spurgeon, of Liberty, Missouri.

NOTES.

Electric Lighting.—We are informed that the Electrical Power Storage Company has just effected an arrangement for some valuable improvements in the construction of its accumulators. In future, boxes will be dispensed with, as also the metallic connections in the battery from cell to cell. The superficial area occupied by the accumulator is reduced to a minimum, and no doubt appears to be entertained that the new type will dispose of the only inconveniences which very extensive employment have made evident. It will be obvious that some time must elapse before the necessary preparations are completed at the manufacturing establishment, but it is hoped that by January next, a continuous supply can be made. In the meantime, unless in cases where it is absolutely necessary for the commencement of contracts, the company desires to withhold the supply of the present type. The new construction will allow a reduction in the prices of the accumulators.

Lord Thurlow has introduced the electric light into Dunphail House, Morayshire, and he now proposes to extend it to the offices and home farm, and use it in the thrashing and other mills on the estate. The motive power is derived from a turbine.

The Canadian Government is making arrangements for an experimental trial of the electric light, during the next Parliamentary Session, in the dining-rooms, restaurant and corridors of the Parliament building. Should the experiment prove successful, the electric light will be extended to other parts of the building.

St. Matthew's Church, Brixton Road, was illuminated by electricity last Sunday evening. This is one of the first instances of the use of the electric light in an established place of worship. The system was the Fyfe-Main, the inventors of which have, as our readers are aware, established an extensive lighting station in the vicinity of Brixton Railway Station. To light the edifice four arc and 60 small incandescent lamps were brought into requisition. The former were placed in the roof, while the smaller lights were distributed over the lower parts of the building. The result was very satisfactory, the church being suffused by a fine softened light, of great steadiness. The lamps, we believe, will be permanently used in St. Matthew's Church.

The Brighton Town Council will, at the meeting on Tuesday, receive a special report from the Gas Committee, recommending it to purchase certain property offered for sale in West Street and South Street, at a cost of £7,500, for an electric-lighting station, and to make a compulsory purchase of other property near to enlarge the site. The committee also recommends that application be at once made to the Local Government Board for permission to borrow £60,000 to cover the cost of these purchases, and the provision of the necessary buildings and machinery for supplying the compulsory area under the Brighton Electric Lighting Order, 1883, and the whole of the sea front, with the electric light. Early this year the Banqueting, Music, and Drawing Rooms at the Royal Pavilion were fitted with the electric light. At the same meeting of the Council the Pavilion Committee will recommend a further expenditure of £2,000 to similarly fit the King's Apartments, Picture Gallery, Library, Museum, Dome, and Corn Exchange.

Last week, it is said, an official of the Hungarian State Railways, Pesth, in arranging the electric light carelessly handled the wires and was instantaneously killed by the current.

The electric light is making considerable progress as a means of lighting up large country mansions. We understand that Messrs. J. Edmundson & Co., of 19, Great George Street, Westminster, who make a specialty of lighting country houses, have a great many installations in hand. Among other works, this firm has at present in course of operation, or recently completed, the following country mansions:—Didlington Hall, Norfolk, for W. A. Tyssen Amherst, Esq., M.P.; Memblane Hall, Ivybridge, for E. C. Baring, Esq.; Warter Priory, near Hull, for C. H. Wilson, Esq., M.P.; Linden Park, Hawick, for Walter Loing, Esq.; Chesterford Park, Saffron Walden, for G. W. Brewis, Esq.; and Glendalough House, Co. Wicklow, for C. W. Barton, Esq. Messrs. Edmundson & Co. are also introducing the electric light into a large new mansion at Champion Hill, building for Egmont Bieber, Esq. In all these installations the "Swan" incandescent lights are used, the motive power being in some cases steam, in others gas engines, whilst in two cases sufficient water-power has been obtained to work turbines. The various fittings are all designed and manufactured specially, and in some cases are of very elaborate design.

A very successful application of the Ferranti system to the lighting of a woollen factory has recently been made at the works of Messrs. George Brook, jun., & Co., of Bradford, the result being so entirely satisfactory that the firm has decided not to lay on gas, the mill being therefore entirely dependent on the electric light for its illumination. An experiment was, in the first place, made by fixing on to the looms incandescent lamps on movable brackets, but this plan had to be abandoned in consequence of the vibration of the frame of the looms, caused by the motion of the shuttle frame. The lamps were next fixed on telescope brackets with movable joints, suspended from the roof over the

looms, so as to admit of the lamps being moved about in any direction. The efficient lighting of every part of the looms was thus fully secured. A part of one of the largest woollen factories in Huddersfield—that of Messrs. John Taylor & Son—is now fitted with 200 incandescent lamps, run from a "Ferranti" dynamo machine. Both the installations were made under the personal direction of Mr. Alfred Thompson, of Ferranti, Thompson & Ince, Limited.

At a recent meeting of the Newington Vestry, the Finance Committee recommended the payments of accounts amounting to £3,921 6s. 10d., £295 15s. 6d. of which was for Messrs. Simson, Wakeford & Co.—"Parliamentary agents' charges, relative to the application for a license under the Electric Lighting Act, including the fees of counsel, and £10 10s. to Mr. Shoolbred for attending public inquiry." To the motion that the report be adopted an amendment was submitted, that the item of £295 15s. 6d. be struck out, and, after discussion, the committee's recommendation was adopted by 30 to 13. A lengthy report was then received from the Works Committee on the question of electric lighting, the following recommendation being submitted :—"That this vestry is still of opinion that they should become the undertakers for the supply of electricity, under the Electric Lighting Act, 1882; that the vestry ascertain the views of the ratepayers as to whether they should have control or otherwise of the new light, and that the Works Committee be empowered to carry out the necessary arrangements for giving effect to this resolution." An amendment was also moved to the motion for the adoption of this recommendation, "That the next business be proceeded with," and was ultimately carried by 26 to 22.

Chambers which are being constructed under the North Terrace, Windsor Castle, near the Royal Library, for the reception of the electric lighting machinery are nearly finished, and will shortly be ready for the apparatus which is to assist in illuminating the palace. The ivy-covered face of the terrace wall has been pierced with windows overlooking the slopes.

Telephonic.—The third annual *conversazione* of the National Telephone Company, Limited, Glasgow, was held on Friday evening, the 19th ult., in the Fine Art Galleries, Sauchiehall Street. There was a large assembly, including a number of subscribers, and representatives—ladies and gentlemen—were there by invitation from the company's various centres in Aberdeen, Belfast, Dundee, Edinburgh, Greenock, &c. In the course of the evening Wm. Alexander Smith, Esq., resident director, occupied the chair, and was accompanied on the platform by Messrs. P. Rottenburg, J. E. Watson, L. Cowan, J. L. Mitchell, D. J. Smith, and George Melville. At the outset the chairman read letters of apology from Sir Wm. Thomson, Lord Provost Ure, &c., and after regretting the absence of Col. R. Raynsford Jackson, the chairman of the company, who was unable to be present, congratulated those present on the progress which the telephone had made in Glasgow. It was only two-and-a-half years since they had introduced to Glasgow one of the greatest triumphs of modern science—that useful invention the telephone. When he recollected the beginning of this company amid a chaotic mass of telephonic arrangements and inventions, and when he looked round him and remembered what the telephonic system was now, they would agree with him that he was entitled to feel somewhat proud at their having arrived at their present high standard of excellence. Then, as it was well enough known, the subscribers numbered about 290 in Glasgow, and they now figured above 700, in addition to over 200 private lines. Over these fully 4,000 messages passed daily. The chairman then compared the number of messages passing over telephone wires with the number transmitted along telegraphic wires in the metropolis, and drew conclusions from statistics favourable to the telephone company. One thing he was glad to say, that the success attending the establishment in Glasgow was repeated in Aberdeen, Dundee, and the other centres of the company, and they had now over 4,000 miles of line wire. The chairman then briefly referred to the *esprit de corps* which existed between the various districts, and after referring to the advantage to be gained by attending the company's electricity classes, cautioned the younger members on the evil result of delaying to acquire a technical and scientific knowledge of their profession, as "the mill could never grind with the water that is past." A vote of thanks was awarded to the *conversazione* committee for the successful manner in which they had catered for the enjoyment and comfort of those present.

The United Telephone Company and the London and Globe Telephone Company.—We learn from various sources that these two companies are becoming more peaceably disposed towards one another. It seems probable, from what we can gather, that means will be found to obviate the necessity of further litigation between them, which amounts, we presume, practically to a working arrangement between them, and this would naturally lead eventually to a complete fusion of interest. The latter event may, however, require considerable time to conclude, for it must be a somewhat intricate matter to set relative values on two companies, in the same line of business, but so differently situated. The one has expended a very large amount of capital for patents on the one hand, but has the advantage of a large going business; the other has sunk nothing like so much on patents, but has a comparatively small business at present.

Fall of a Telephone Wire.—An alarming accident occurred in the City shortly before 11 o'clock on Saturday morning last, through the falling of a telephone wire. Several workmen in the service of the London and Globe Telephone Company were engaged in removing wires extending from 3, Frederick's Place, Old Jewry, across Gresham Street, to Gresham Buildings, Basinghall Street, when a wire slipped through the hands of the men before it was secured by a guiding rope, and came down with a crash among the people in the crowded street. A number of gentlemen had their hats knocked off, and there were several very narrow escapes. The most serious injury was sustained by Mrs. Emma Street, an elderly lady, of 93, Englefield Road, Islington. She was badly cut across the head and face.

Fraud by Telegraph.—The *New York Tribune* of the 14th ult. states that on the previous day the wire of the Western Union Telegraph Company between the city and Jerome Park was "tapped" by some skilful swindlers, who sent all over the country false reports of the races in the park. The fraud was not discovered until late in the evening, when the swindlers and their confederates in various cities had "netted" about $80,000. No trace of the operators has been found.

Underground Telegraph Wires.—The principal manufacturers, such as the Telegraph Construction, India-rubber, and Siemens Bros., Companies, have, respectively, received substantial orders for early delivery of these telegraph wires on postal telegraph account. Altogether, we believe, a total of about four or five thousand miles has been ordered. The intended sixpenny rate will prove beneficial to the electrical manufacturers, if not to the public; we have, however, but little doubt that the commercial world will benefit generally by the reduction of the tariff.

New Cables.—Considerable activity is manifested in this branch of electric work at the present time. The Telegraph Construction and Maintenance Company has, we understand, an order for 260 knots for repairs to the St. Vincent-Pernambuco section of the Brazilian Submarine Company. Report also states that the Construction Company is likewise making

3,000 miles of cable to duplicate the Madeira-St. Vincent and St. Vincent-Pernambuco sections, although the official order has not yet been given. Messrs. Siemens Bros. Company is manufacturing two Atlantic cables for Mr. Bennett and a few influential friends.

Clynch v. The Electric News Telegraph Company, Limited.—In the City of London Court on Monday, before Mr. Commissioner Kerr, an action was brought by Charles Clynch, a telegraph lineman, of 20, South Street, Finsbury, against the Electric News Telegraph Company, Limited, of Ludgate Circus, to recover damages for alleged wrongful dismissal. The plaintiff stated that after having been in the employ of the defendants for some time at a weekly wage he was summarily dismissed on a Friday morning, having been paid only up to the previous night. His Honour: But there must have been some reason for dismissing you; what was it?—Plaintiff: I really cannot say. I have an idea that it was because I would not steal on to the roof of No. 7, Winchester Buildings, City, to attach a wire to part of it, without the consent of the housekeeper.—The defendants' solicitor: I shall prove that he positively refused to do his work according to instructions. If he were told to fix the wire upon a particular building it was his business to do it. The company would be liable for any wrong, not he, and beyond that he absented himself without consent.—Plaintiff: That I deny. On the day previous to my discharge Mr. Lambry, my manager, gave me permission to attend a funeral with my fellow-workman, and hence my absence.—Mr. Lambry was called, and denied having given the permission, and stated that in addition to absenting himself without leave he refused to work with another man, and had destroyed the communication in a wire which he was fixing by puncturing the gutta-percha covering, thereby causing the current to "run to earth."—His Honour said as it was oath against oath he gave the plaintiff leave to have a trial by a jury.

Lightning and Steamships.—Six months ago, says the *Panama Star and Herald*, when entering the Bay the Pacific Steam Navigation Company's steamship *Colombia* was struck by lightning. The vessel was not injured, as the conductor on the foremast conveyed the flash into the sea, but the forward part of the vessel was so powerfully magnetised by the current that alterations have to be effected. When running on certain courses the compasses are untrustworthy, and the movement of the wheel is sufficient to deflect them. Captain Bass, who is now in command of the *Colombia*, believes the steering chains and the wheels they travel on have been magnetised by the electric current, and when the vessel reaches Callao they will be changed. The magnets on board were all demagnetised and reduced to the condition of ordinary iron. The circumstance is rare, if not entirely new, and will attract the attention of seamen.

The Jablochkoff Electric Light and Power Company, Limited.—Two petitions for the winding-up of this company are set down for hearing before Mr. Justice Pearson in the Chancery Division of the High Court of Justice on Saturday, the 10th inst.—one presented by Mr. James Willing, jun., 353, Strand, W.C., and the other by Mr. Arthur Stuart Pennington, Bolton.

Ben Nevis Observatory.—The Ben Nevis telegraph cable was successfully completed on Thursday week, and communication opened with the Post Office at Fort William, thus placing the highest point in Great Britain in communication with the rest of the civilised world.

Societe Internationale des Electriciens.—This Society, lately established in Paris, now numbers 830 members, 70 of these being English. The date up to which candidates will be admitted as "original" members (membres fondateurs) has been deferred to the day of the general meeting, which takes place on the 15th inst. Subscriptions will be received from, and statutes and forms of subscriptions sent to, any applicants for membership, by Mr. J. A. Berly, C.E., 16, New Bridge Street, London, E.C.

Electric Railways.—Professor Fleeming Jenkin, LL.D., opened the class of engineering in Edinburgh University on Tuesday, by a lecture on "Telpherage," a name which in his first patent on the subject, he said, he had given to the transmission of vehicles by electricity to a distance independent of any control exercised from the vehicle. The line consisted of a series of poles with cross heads and strong wire ropes stretching along each side, one to form the up and the other the down line. On the wires ran a motor engine which completed the circuit from a stationary electric machine. Following the engine were a series of wheels from which were suspended, clear of the poles, buckets or "skeps," each capable of carrying a net quantity of about 2½ cwts. of goods. Train could succeed train, and the buckets be taken off or put on the line without interfering with the others. As the line did not require bridges or viaducts, and could be constructed over a rough country at small cost, he considered it would be useful for the conveyance of minerals, wool, grain, or other articles that could be divided into quantities such as the buckets could carry. The line would supersede the wire tramways at present laid between mines and the sea, because it could be worked round curves of a greater radius and up steeper gradients. It would provide the cheapest mode of inland conveyance for small quantities of goods, especially in new colonies where the roads had not yet been constructed, and during war it would be a ready means of sending supplies to the front. He considered also that by placing poles on the surface of the ice and making the ships the centre of supplies, the Telpher line might enable explorers to reach the North Pole. (Laughter.) He did not think that the line would supersede railways, but that it would rather be a means of bringing traffic to them, while it would improve the condition of agriculture by not only providing readier means of conveyance, but by enabling agriculturists to draw from the line supplies of power for various kinds of work. We shall publish Prof. Jenkin's lecture in full next week.

The Society of Telegraph Engineers and Electricians.—At the ordinary general meeting of this society on Thursday evening, Mr. Willoughby Smith, the president, will read a paper on "Volta-electric Induction," illustrating it by experiments.

Death of M. Louis Breguet.—The death is announced of M. Louis Bréguet, whose labours in the domain of natural science have gained for him a wide celebrity. He was 75 years of age.

The late Mr. W. Spottiswoode, F.R.S.—It has been suggested that the Spottiswoode Memorial should take the form of an endowment for a pension in perpetuity, to be called "The William Spottiswoode Memorial Pension," the proceeds to be devoted to the sustenance of an incapacitated printer or widow.

The New Patent Law.—With the object of affording information to the public until the new rules under the Act are completed, the following is issued by direction of the Board of Trade:—

1. Applications and all other documents will be required upon strong wide-ruled foolscap paper (written or printed on one side only), having a margin of two inches on the left-hand part thereof. The use of parchment will be discontinued. Copies of specifications will no longer be required.

2. The sizes of the drawings will remain unchanged, but they will be required upon drawing paper instead of on parchment. A copy of the drawings will be required upon thin Bristol board.

3. Forms of application (stamped) will be placed on sale at the chief post-offices in the United Kingdom.

4. The forms required for an application will be—(*a*) for provisional protection: application form and form of provisional specification. (*b*) for complete protection: application form and form of complete specification. Where a complete specification is not left in the first instance, it may be left at any time within nine months after application for provisional protection.

5. The fees will be £1 for each stamped form of application, and £3 for each stamped form of complete specification. No fee will be charged for the form for provisional specification.

6. Applications may be left at the Patent Office or sent by post. If sent by post they must be addressed to the Comptroller, Patent Office.

7. The "declaration" in the application form must be made by the inventor or inventors. All other documents may be prepared and signed by agents.

NOTE.—"Applications" for Letters Patent made during the present year must be proceeded with in accordance with the existing laws and rules.

H. READER LACK.

Office of Commissioners of Patents,
25, Southampton Buildings, Chancery Lane.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Hygienic and Electric Association, Limited.—By an agreement dated September 25th, registered on 25th ult., this company will purchase the business of manufacturers and vendors of all kinds of goods to which electricity, galvanism or magnetism can be applied, carried on by Messrs. M. G. Totterdell of Landport, O. P. Boret of 21, Soho Square, W. H. de Cartaret of 7, Chevaley Road, New Wandsworth, and W. J. Tuck of Portsmouth, trading as the Universal Hygienic and Electric Association at 3, Mall Road, Hammersmith. The consideration is £10,000 in fully-paid shares. Registered office: 285, Lake Road, Landport, Hants.

Jablochkoff Electric Light and Power Company, Limited.—The annual return of this company, made up to the 18th ult., was filed on the 26th ult. The nominal capital is £300,000, in £5 shares. 38,545 shares have been taken up, being an increase of 19,585 over the shares issued at the same period of last year. The full amount has been called up, the calls paid amounting to £182,131 5s., leaving £12,673 15s. unpaid. The sum of £1,456 has been paid upon 416 shares forfeited. Registered office: 1, Great Winchester Street Buildings.

Brush Electric Light and Power Company of Scotland, Limited.—Special resolutions were passed and confirmed at extraordinary meetings of this company, held on September 28th and 16th ult., authorising the voluntary winding-up of the company, and nominating Mr. Robert Ewing and Thomas Dickson as liquidators. These resolutions were duly filed on the 24th ult.

Patent Self-Binding Telegraph Insulator Company, Limited.—The statutory return of this company, made up to August 21st, was filed on the 4th ult. The nominal capital is £5,000, in £1 shares. 2,000 A and 927 B shares have been taken up, and upon the former the full amount has been called, and 15s. per share upon the latter. The calls paid amount to £2,640, leaving £55 5s. unpaid. Registered office: 28, Hamilton Street, Birkenhead.

Chamberlain and Hookham, Limited (Electric Light Engineers).—The statutory return of this company, made up to August 27th, was filed on September 5th. The nominal capital is £100,000, in £10 shares. 1,000 A and 5,000 B shares have been issued; upon the former £1 10s. per share has been called and paid, the latter being considered as paid. Registered office: 4, New Bartholomew Street, Birmingham.

Phœnix Memnon, Limited.—The annual return of this company, made up to August 30th, was filed on September 8th. The nominal capital is £1,600, in £8 shares, all of which are taken up. £6 per share has been called, the calls paid amounting to £272, leaving £928 unpaid. Registered office: Baker's Lane, Buckden, Huntingdon.

NEW COMPANY REGISTERED.

Edison and Swan United Electric Light Company, Limited.—Capital, £1,000,000, divided into 150,000 A and 50,000 B shares of £5 each. Objects:—To acquire the business and properties of the Edison Company and of the Swan Company, except only the foreign and colonial patents. Signatories (with one share each):—*J. S. Forbes, 14, Ashley Place; *Viscount Anson, 5, Granville Place, W.; *Major-General J. S. Trevor, 75, Ladbroke Road, W.; *Shelford Bidwell, Southfields, Wandsworth; *E. W. Batt, 20, Great Winchester Street; *Arnold H. White, Hampstead; *Captain E. Villiers, 9, Glendower Terrace, South Kensington. Directing qualification, 200 shares; remuneration, £3,000 per annum, with an additional £1,000 for each 1 per cent. profit on the entire capital paid up, should such profit exceed £7 per cent. on the amount paid upon the A shares; such remuneration must in no case exceed £8,000 per annum. The signatories are the first directors. Registered 26th ult., by Ashurst Morris Crisp & Co., 6, Old Jewry.

* Those signatories whose names are preceded by an asterisk are also directors.

American West Coast Telephone Company, Limited.—The registered office of this company is 4, New Broad Street, E.C.

West London Electric Lighting Company, Limited.—The registered office of this company is at 26, Austinfriars, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

The Brazilian Submarine Telegraph Company, Limited.

THE twentieth ordinary general meeting of the shareholders was held at the Cannon Street Hotel on Friday of last week, Viscount Monck, the chairman of the company, presiding.

The Secretary (Mr. R. Collett) read the notice convening the meeting, and the directors' report, which we published in our issue of the 20th ult., was taken as read.

The Chairman then said:—It now becomes my duty, in moving the adoption of the report and accounts, to address to you a few observations. The report, as you will see at a glance, consists of two distinct parts, one giving a report of the transactions of the company up to June 30th of this year, and the other, by a slight anachronism, an account of transactions which have taken place since that date. If I had to deal only with the report proper for the half-year ending June 30th last, my task would be a very light one, and my observations would be very brief. I should have to report to you the same continuance of prosperity in our undertaking of which it has been my privilege to have been the interpreter for the last 10 years. Your receipts maintain themselves. There was a very slight increase, easily accounted for by the length of time we have been working, in the working expenses, but there was nothing either in the one or the other, which tended in the slightest degree to diminish our power of making all the payments, and of giving you the dividend which we have hitherto given. I shall dismiss that portion of the report with these observations. Of course, if there is any question which any shareholder wishes to have answered with reference to the accounts and of the receipts, I shall be happy to give any information in my power, as we have always desired to do to the shareholders. But there is really nothing in the accounts to distinguish them from those which have preceded them, and we were fully prepared and intended on June 30th to have given you the usual dividend, with a bonus of 1 per cent., which we have paid for the last two years. There was only one observation which I should have had to make had we held our meeting on July 1st, and that is, that our electricians reported to us that the section of the cable reaching from Madeira to St. Vincent had developed a certain diminution of insulation. I believe that experts will tell you that, although that is more or less against the cable, it was quite consistent with its continuing to work for a very long time. This state of things continued until the month of September, but on September 22nd, like thunder proceeding out of a clear sky, without any warning whatever, we received intelligence that the section of the cable between St. Vincent and Pernambuco had ceased to work. I wish to impress upon you that this was absolutely without notice. I am informed that on the evening before the suspension of the cable the tests were as good as they had ever been since the cable was laid. Of course, until we raise this cable it is impossible to say what the cause of this suspension may be. But as a matter of speculation I cannot refrain from thinking there is some connection between it and the great volcanic disturbances which have occurred all over the world, for which this year has become so notable. Be that, however, as it may, we received the intelligence on September 22nd. It was, as you are aware, a period of the year when we were all away on our holiday. Fortunately my excellent friend, our managing director, was in London. He immediately communicated with me by telegraph, and immediate steps—I think within 24 hours—were taken for the fitting out of a repairing expedition. I have received a printed circular—an anonymous circular—on this subject, and I have no complaint to make whatever with the tone of this circular. I think the shareholders are entitled to full information as to an occurrence of this kind, and the conduct of the board of directors is in this respect, as in all others, open to

fair criticism. But one of the criticisms which is made in this circular is, that no preparations were made for such a catastrophe as has happened. Now, when such an allegation as that is made, I think, as in all other arguments, it would simplify matters if we would define our terms. What is meant by preparations for repairing? One of those preparations, of course, would be to keep in stock a large quantity of cable ready made. We had a limited quantity of cable in stock, but I am not quite sure that that preparation was one which commended itself to the minds of all the shareholders of this undertaking. (Hear, hear.) I think it is within my own memory that on one or two occasions I was taken to task for keeping cable in stock, and thereby rendering unproductive a certain amount of the capital of the company. I need not say these two criticisms are perfectly inconsistent the one with the other, and I am disposed to set them off the one against the other. Another item of preparation is the maintenance of a ship. Now, in many cable companies there are repairing ships. For instance, the company of which I have the honour to be chairman—the Anglo-American Company—have a repairing ship constantly at Newfoundland, but the reason of that is that we have on the other side of the Atlantic a large number of submarine cables in shallow water. These cables in shallow water are liable to casualties which do not occur to cables in deep water, and a comparatively inexpensive ship is capable to undertake the repairs of them. But in this case the break, as far as we can find out, has taken place in about 2,000 fathoms of water. In order to lift the cable and repair it in that depth of water, you require a large ship, well found and thoroughly fitted for the purpose, and it would never pay us to maintain perpetually a ship of that class to make repairs in deep water. You may rely upon it that the only real preparation for a disaster of this kind is to have the money in hand—(applause)—ready to accomplish an object, and that we have and had. (Hear, hear.) I have already stated that the order to repair was given within 24 hours of the suspension of the cable, and I may tell you that the expedition will sail in the end of this month. The fact was that the Telegraph Construction Company were obliged to manufacture cable for the purpose, because it would not do to go out to repair such a fault as this without a sufficiency of cable to make a good job of it. So much for the repairing. I may say that all the experts are sanguine that they will be able to make an effectual repair of the cable, and to restore it to its former condition. My own experience leads me to the same result, because we picked up and repaired in the Atlantic last year, or the year before, a cable two or three years older than this, which from the beginning never was as good a cable as this was, and at a depth of water equal to that in which this fault has occurred. So much for the repairing expedition. But there lies behind it a more serious question, and that is, the necessity or propriety of at once duplicating our whole system. Now, in considering this question, of course if we were able to contemplate the certainty of the repair we should not embark at once in the enterprise of duplicating the cable, but I need not remind you that in all matters of this kind the safe plan is to contemplate the worst that may happen—not to speculate on everything turning out favourably—(hear, hear)—and it appears to me that supposing—assuming for one moment, though I do not at all admit the probability of it, but there is a possibility—that we fail effectually to repair this cable, the loss which would be produced by the complete suspension of our traffic would be a danger—a risk—which we sitting at this table think we ought not to incur. We have determined to duplicate the whole system; and I may tell you that we have a tender which will enable us to perform the work, with the assistance of our reserve fund, without raising one shilling of additional share capital. (Applause.) We have also the assurance of our electricians that we shall have, when this duplication is completed, the cheapest deep-sea cable that has ever been laid. We have not concluded any contract as yet, because, until we fully explained the state of things to the shareholders, we did not think it was right we should do so, but I have explained to you what we can do, and I very much mistake the minds of the shareholders of this company if they do not think we ought to carry the work into effect as quickly as possible. (Applause.) So much I have told you as to what we contemplate with respect to the duplication. No doubt it is very disagreeable to have to meet our shareholders for the first time in the company's existence with a statement of disaster, but on the other hand I may tell you—you are aware of it—we have already duplicated the Lisbon-Madeira section, and it is in as good condition as it is possible for a cable to be. The Madeira-St. Vincent section has developed a fault, but it has developed no fault that we may not hope almost with certainty to repair. The St. Vincent-Pernambuco section is, as you are aware, broken down, but we have the strongest possible ground for the conviction that we should be able to repair it; but, as I have already said, there is the possibility of our being unable to do it, and there is also this consideration, which seems to me to operate strongly in favour of the duplication, which is, that having duplicated our cables, and having got a new set of cables through the whole system, we shall be able at our leisure to make these old cables as good as the other ones, which we could not do with satisfaction if we were obliged to suspend our earnings. There is no doubt it is not pleasant to meet you with this account of our affairs, but there is no reason for losing heart in the matter. We have up to this time been most successful, and have enjoyed, compared with other cable companies, an extraordinary immunity from misfortunes of this kind. I think, at the same time, like other misfortunes in human life, there is some reason for congratulating ourselves on the circumstances in which we find ourselves. The policy of this company has always been the accumulation of a substantial reserve fund. You now see the advantage of it. You are now able to duplicate your property without increasing the amount of your share capital. There is another sympton which has attended this disaster, and which I should like to refer to. On occasions of this kind I am quite sure that those domestic white animals, which are supposed to prowl about the Stock Exchange, a tribe of *Ursa* major and minor, have been quite willing to make a good thing out of our misfortune. The quotation of your shares in the market shows that that is an impossibility on their part, and I attribute the way in which the shares have kept up their price—they are still above par—mainly to the confidence which the public has in your stability as a company, based on the large reserve fund which they are aware you possess. (Hear, hear.) I believe it also shows the confidence of our shareholders in the mode in which their affairs have been hitherto managed. (Hear, hear.) I have little doubt—in fact, if it were not presumptuous I would almost say we had a certainty, that we shall within a few weeks revive your cables, recommence the receipt of our income without suspending for one moment the payment of those dividends which you have been accustomed to receive. Having made these observations, I will now place before you the resolution which it is my duty to move:—"That the report and accounts of the directors to June 30th, 1883, now submitted, be and are hereby approved and adopted, and that a dividend be now declared of 3s. per share, making, with the interim dividend, a total dividend of 6 per cent. for the year ending June 30th, 1883."

Mr. Spicer, in a long desultory speech, opposed the proposed cable duplication, stating he considered that it would be a waste of money, as, if the defective cable were repaired, there was no doubt it would last to the end of their concession—it might last perhaps a hundred years. (Laughter.) If they went on as suggested they might say good-bye to any increase of dividend during the remainder of their concession, and at the end of the concession their property would unquestionably be doomed. He moved an amendment, that a committee be appointed to inquire into the proposed cable duplication, and report to the shareholders.

Mr. Bryce seconded the amendment.

The Chairman: I hope that Mr. Spicer will not consider it disrespectful on my part to him if I decline to follow him through the long statement which he has addressed to the shareholders. (Hear, hear.) Mr. Spicer has concluded his remarks by an amendment, which means neither more nor less than that he and those who vote for it entertain no confidence in the mode in which this company has hitherto been managed. I know a good many faces I see around me. They have surrounded me during the last 10 years during which I have been chairman of the company, and without a single further word I venture to put the amendment, with the certainty that it will be negatived by a very large majority. (Applause.)

The amendment was then put to the meeting and rejected, the mover and seconder of it only supporting it.

Mr. Griffiths supported the proposition to duplicate the cable, stating that the cables were becoming old, that there was a danger of their wearing out, and that if they did so their business would at once be destroyed.

In replying to Mr. Matthey,

The Chairman said the outside limit of money which it would be necessary to raise in order to duplicate the cable would be about £250,000. The shareholders would have the first offer in debentures; any portion they might not take up had already been provided for.

The report and accounts were then unanimously adopted.

Sir James Anderson and Mr. St. John F. Brodrick, M.P., the retiring directors, were re-elected, as were also the retiring auditors, Mr. Henry Dever and Mr. John Gane.

A vote of thanks to the chairman and directors closed the meeting.

The West India and Panama Telegraph Company, Limited.

THE thirteenth ordinary general meeting of the shareholders was held at the Cannon Street Hotel, on Wednesday, Mr. C. W. Earle, the chairman of the company, presiding.

The Secretary (Mr. R. T. Brown) read the notice convening the meeting, and the report of the directors, which we published in our last issue, was taken as read.

The Chairman, in moving the adoption of the report and accounts, said the six months which they covered were, perhaps, the least eventful they had had during the time the present directors had been in office. The communication of only one station out of the 23 had been interrupted. In that immunity from interruptions the directors took the opportunity to continue their investigations in regard to the very important cable between Jamaica and Porto Rico. That cable had been in operation since the present board took office. The directors had not yet had time to investigate certain portions of it. During the last half-year they found that there was a considerable part of it in very good condition, and they therefore resolved to bring home their ship, the *Grappler*, which had been a considerable time in the West Indies, to overhaul her, which could be done more cheaply in this country than in the West Indies, and then to despatch her with a supply of cable for repairs and to replenish their stock. They therefore called for tenders and they obtained 250 miles of cable at the lowest rate, he thought, they had ever had in their experience. With that

cargo of cable the *Grappler* sailed. She arrived at St. Thomas on the 20th, and on the 29th she left to pick up the end of the cable near Porto Rico. That repair might run into a great deal of money, and, in fact, if they found they could not complete that repair, the amount of capital that cable represented would have to be written off before they could pay any dividends at all. Turning to the accounts, it was satisfactory to find that on the revenue side they had the largest receipt of revenue they had ever had. It was £6,000 more than it was in the corresponding period of the last year, and the amount of receipts in that, again, was in excess of anything they had previously had. That £6,000, it must be remembered, was partly the results of an accident to another line. About £2,000 came to them in traffic receipts caused by the interruption of a competing line laid down to Panama along the west coast of the Isthmus. That was an accidental element in the increase. The increase in the subsidies, about £2,400, was thoroughly satisfactory in every way. It indicated that the colonies were beginning to have more confidence in them—to appreciate what they were doing in the way of securing communications which were of so vital importance to them, and, altogether, it was a most satisfactory indication of better feeling. That feeling was indicated, there was no doubt, both in Trinidad and British Guiana. That, he thought, resulted from the prudence and the self-denial, he might call it, of the shareholders in forming their reserve fund. He had the pleasure of meeting the governor the other day, Sir John Glover, and on speaking to Sir John on the subject, the latter assured him of the good feeling existing now in the colonies towards them, and he (the chairman) thought they might expect an increased grant. The general aspect of their position was, he (the chairman) thought, improving very much, and that improvement, he considered, was, no doubt, attributable, to a great extent, to their prudence in setting aside that strong reserve fund. The policy they had pursued had certainly borne good fruits; he should like to read to them what the Governor of Trinidad wrote to him under date 24th July, in communicating the increase the colony had granted. He says:—"I have, however, reconsidered my decision in view of the great effort the company has lately been making, and is continuing to make, to improve its cable communication, which have proved beneficial to this colony, and I have sanctioned the increase of the subsidy from the commencement of this year, which the Crown agents will be instructed to pay." They had all of them, he dared say, received a circular that morning or on the previous night, indicating a policy which they ought to pursue, but which he thought it would be most dangerous at the present juncture for them to give effect to. It advocated a large increase of their capital account. Now, pending the negotiations they were still carrying on in the colonies, pending the results of their attempt to repair the Porto Rico cable, he did think anything like an increase of the capital account would be fatal to them. He thought nothing could be more suicidal than the following of such a course, and he was sorry the circular had been issued, because it indicated to the colonies that the company was trying to get all they could out of them. The gentleman who published the circular was not a shareholder of the company, and he did not know what philanthropic or incentive motives he had in taking such an interest in the company's concerns, but he thought the step proposed would not be conducive to the interests of the company at present. As time went on, they should have to consider what was to be done with the arrears. He thought there was evidence of their being in a better position, if that gentleman would only let well alone and let them carry out what they were doing at the present moment. (Applause.) He hoped that whatever discussion took place, it would not be of such a nature as would prejudice them in their relations with the colonies. He moved "That the directors' report and accounts to the 30th June, 1883, submitted to the meeting be, and the same are hereby adopted, and, as recommended by the board, a payment of 3s. per share on account of arrears on the first preference shares be, and the same is hereby declared."

Mr. W. Ford seconded.

In replying to shareholders,

The Chairman said one proprietor wished them to pay away their reserve fund and satisfy the arrears on preference dividends, but he could not think that that would be a wise step. The reserve fund was really a security to the whole property and a great inducement to the colonies to help them on. He could not conceive anything would be more dangerous than their paying away the £60,000 they had now invested to the preference shareholders. It would leave them practically without a reserve fund, and it would not be a wise thing to do in any way. The same proprietor had also said that they would then have a fair reserve fund. He did not know what he considered a fair reserve fund. It would leave them a nominal £20,000 against plant represented by 4,000 miles of cable. As to the loans on securities, hitherto, not knowing when they might want that money, they had lent it on the Stock Exchange on securities. The rates of interest varied, but they were receiving considerably over 2 per cent. They were now going to invest part of that money on substantial securities. In regard to the directors' fees, he had often said he was not anxious to be there; the directors were elected by the shareholders. The directors were asked, at the reformation of the company ten years ago, and they had nothing to do with it then—it was in a dreadful mess—to become directors, and there were certain terms laid down. He was not paid nearly so much as were the chairmen of many other companies, and he was perfectly willing to place his seat at their disposal, but as long as he remained there he did not see why he should not draw his fees, and he thought most of his colleagues were of the same opinion. If they could get other directors to take their places they were at their disposal, and any change they liked to make they would assent to. He was constantly in the office himself, and they had the experience of gentlemen who had managed telegraphs since telegraphs were made, and they could not expect gentlemen to leave other employments and take up the business of the company for nothing. (Hear, hear). They were still without reply from the Secretary of State in regard to the proposals mentioned in their last report, further than that they must wait the report of the commission sent out to the West Indies to inquire into the finances of the West Indies. They expected a reply shortly. The expenses of the company, compared with those of other large companies, were moderate.

The report and accounts were then unanimously adopted.

A vote of thanks to the chairman and directors closed the meeting.

The Eastern Telegraph Company, Limited.—This company notifies the repair of the Java-Australia cable, thus restoring telegraphic communication with Australasia. Mr John Pender, M.P., the chairman of the company, having completed his inspection of the company's stations in the Mediterranean, returned to London on Friday of last week.

The Telegraph Construction and Maintenance Company, Limited.—The seventeenth distribution on the certificates issued under the trust deed of March 12, 1875, fell due on Thursday. The distribution, which arises from dividends on the shares held by the trustees, is at the rate of 1s. 4d. per £5 certificate, payable two clear days after presentation of Coupon No. 17 at Messrs. Barclay, Bevan & Co.'s.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotation, Oct. 31.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	8	2½ - 3	2⅝.
		Do. Do.	10	4⅛ - 5⅛	
30,000	5	Australasian E. L., Power & Storage Co.	3	⅜ - ½	
24,900	10	British Insulite Co., Ld., "A" Shares..	5	1 - 2	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	⅜ - ½	
25,000	5	Gt. Western Electric Light & Power Co.	2½	⅜ - ½	
24,980	5	Hammond Elec. Lt. & Power Sply. Co.	2½	3¼ - 3½	
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	.. ..	
172,500	1	Maxim-Weston Elec. Lt. & Power Co. ..	1	¼ - ⅜	
..	..	Metrop. Brush Electric Lt. & Power Co.	5	.. ..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2	.. ..	
..	..	S. African Brush Elec. Lt. & Power Co.	2½	.. ..	
100,000	5	Swan United Electric Light Co., Ld.	2½	1⅛ - 1⅜	1⅛-1⅛.
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	44½ - 45½	
2,441,800*l.*	Stk.	Do. Pref. } Del. receiving no div. until	100	75 - 76	74⅞-75.
2,441,800*l.*	Stk.	Do. Def. } 6 p. c. paid to Pref.....	100	15 - 16	
150,000	10	Brazilian Submarine, Limited	10	9¼ - 9½	⅛-⅛-⅛-⅞-⅞-⅛-⅛-⅛-⅛-⅛-⅛-⅛
16,000	10	Cuba, Limited	10	10½ - 11	
6,000	10	Do. 10 per cent. Preference ..	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	5⅞ - 6⅛	
6,000	10	Do. 10 per cent. Preference	10	15½ - 15⅝	
65,000	20	Direct United States Cable, Ld., 1877 ..	20	11 - 11⅛	11⅛-⅜xd.
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	98 -101	
380,000	10	Eastern, Limited	10	10⅞ - 11	11-10⅞.
70,000	10	Do. 6 per cent. Preference.....	10	13 - 13⅜	
232,000*l.*	100	Do. 6 do. Debs., repayable Oct. 1885	100	.. ..	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	102 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	104 -106	
199,750	10	Eastern Exten., Australasia & China, L.	10	11⅛ - 11⅞	11⅛.
320,000	100	Do. 6 p.c. Debs., repayable Feb. 1891	100	107 - 110	
500,000	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102 - 106	
140,000	100	Do. do. reg., repayable 1900..	100	103 - 107	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	103 - 106	
254,300*l.*	100	{ Eastern & South African, Ld., 5 p. c. } { Mort. Deb. Rg. redeemable 1 Jan. 1900 }	100	102 - 105	
345,760*l.*	100	Do. do. do. To Bearer..	100	102 - 105	
22,050	10	German Union Telegraph & Trust, Ld.	10	10 - 10¼	
163,390	10	Globe Telegraph & Trust, Ld.	10	7⅛ - 7⅞	7⅞-¾.
163,200	10	Do. 6 per cent. Preference	10	12⅛ - 13⅛	
125,000	10	Great Northern	10	12⅛ - 13⅛	
100,000*l.*	100	Do. 5 per cent. Debentures ..	100	100 -103	
300,000	100	Do. 5 per cent. Debentures ..	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	30 - 31	30⅞.
100,000	100	Do. 6 per cent. Debs., 1886	100	102 -105	
17,000	25	Indo-European, Limited	25	31 - 32	xd.
38,148	10	London Platino-Brazilian, Limited	10	3½ - 4	
197,500	1	Maxim-Weston Electric, Limited	1	⅛ - ¼	
12,000	10	Mediterranean Extension, Limited	10	1½ - 1⅞	
8,200	10	Do. 8 per cent. Preference	10	2 - 4	
9,000	8	Reuter's, Limited	8	8¾ - 9	
280,000	Stk.	Submarine	100	210 -220	
58,225	1	Do. Scrip	1	1⅞ - 2¼	
4,200	Cert.	Submarine Cables Trust	100	102 -105	
37,350	12	Telegraph Construction and Mainten.	12	36 - 37	
150,000	100	Do. 6 per cent. Bonds, 1884 ..	100	101 -103	
185,750	5	Do. 2nd Bonus Trust Cert. ..	2½	1⅜ - 1½	
30,000	10	West Coast of America, Limited	10	4¾ - 5¼	
150,000	100	Do. 8 per cent. Debs.	100	106 -108	
69,910	20	Western and Brazilian, Limited	15	5 - 5⅛	
		Do. Preferred	7½	4 - 4½	
		Do. Deferred	7½	⅛ - 1	
200,000*l.*	100	Do. 6 p. c.. Debs. "A" 1910 ..	100	102 -106	
2,500	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	94 - 97	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	122 -124	
1,020,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1 - 1⅛	1⅛-⅛.
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7⅛	7⅛-⅛
4,069	10	Do. 6 do. 2nd do. ..	10	4½ - 5	
		TELEPHONES.			
154,165	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	⅛ - ¼	
200,000	1	Oriental Tele. Co., Nos. 80,001 to 200,000	¼	⅛ - ¼	
100,000	5	United Telephone Co.	5	8 - 8¼	

NEW PATENTS—1883.

5056. "Improvements in tricycles and other velocipedes or wheeled vehicles actuated by electricity, part of such improvements being applicable to other purposes." Sir D. SALOMONS. Dated October 24.

5065. "Apparatus connected with electric railways or tramways." M. H. SMITH. Dated October 24.

5069. "Secondary batteries or electrical accumulators." J. S. SELLON. Dated October 24.

5072. "Insulators for electrical purposes." E. ROE. Dated October 25.

5078. "Electro-motors and dynamo machines." W. R. LAKE. (Communicated by H. Walter.) Dated October 25.

5081. "Switch apparatus for connecting and disconnecting electrical lines for telegraphic or telephonic communication." J. IMRAY. (Communicated by T. A. Connolly.) Dated October 25.

5082. "Dynamo-electric and electro-dynamic machines." R. E. DUNSTON, A. PFANNKUCHE, J. FAIRLIE. Dated October 25.

5088. "Arrangement of circuits and apparatus for the distribution of electricity." J. S. BEEMAN. Dated October 26.

5103. "Electric gas-lighters." T. TAYLOR, J. TAYLOR. Dated October 27.

5108. "Cut-out for telephones." A. M. CLARK. (Communicated by O. B. Carter, J. T. Fouche, C. A. Fisher, and C. D. Wright.) Dated October 27.

5109. "Generation, storage, regulation, distribution, and utilisation of electricity and apparatus or means therefor, and methods or means to be employed in the construction or operation of such apparatus or parts thereof." J. S. WILLIAMS. Dated October 27.

5110. Same as above.

5111. "Improvements in magnetic garments or clothing for the prevention, relief and cure of disease or complaints of the human body, also applicable to the bodies of animals." G. CAERON. Dated October 29.

5127. "Electrical generators and motors." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated October 29.

5132. "Electrical lamps and dynamo-electric machines." S. Z. de Ferranti. Dated October 29.

5141. "Telephones." W. GILLETT. Dated October 30.

5151. "Transmission of intelligible signals by electricity or 'steno-telegraphy.'" G. A. CASSAQUES. Dated October 30.

5153. "Electric clocks not requiring winding-up." S. SCHISGALL. Dated October 30.

5158. "Incandescent electric lamps and their holders or supports." A. SWAN. Dated October 30.

5159. "Manufacture of incandescent electric lamps." J. SWINBURNE. Dated October 30.

5165. "Construction or arrangement of secondary batteries or accumulators." J. L. PULVERMACHER. Dated October 30.

5166. "Improved construction of galvanic batteries for medical and other purposes, and in apparatus for applying electricity to the body." J. L. PULVERMACHER. Dated October 30.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

659. "Voltaic batteries." W. R. LAKE. (Communicated from abroad by J. M. Stebbins of America.) Dated February 6. 2d. Relates to improvements in electric batteries, and its object is to provide a battery which shall be practically constant for an indefinite length of time, and at the same time furnish a maximum of motive force during its existence. (*Provisional only.*)

661. "Dynamo-electric machines." J. MUNRO. Dated February 6. 6d. Relates to the construction of dynamo-electric machines, and is designed, chiefly, by improvements in the construction of the armatures of the said machines, to effect greater efficiency and cheapness in their construction. In one construction of the improved armature the inventor brings the opposite magnetic poles close together, and between them, as close as possible without actual contact, he rotates, as armature, a disc, set on both sides with radial bars or strips of copper, joined in a grid form, and either running round the borders of the disc, or forming fan-shaped sections on it. These strips are connected together and otherwise insulated so as to give an induced current by rotation, either in two separate circuits, one on each side of the disc, or in a single circuit. The current is led away by suitable collectors or commutators.

676. "Telephonic Apparatus." H. H. ELDRED. Dated February 7. 6d. Relates to telephonic apparatus of the type of what is known as electro-magnetic telephones, and has for its object increasing their efficiency and facilitating their use and manipulation. In carrying out one part of the invention, in order to effect these objects, the inventor employs a parchment or membraneous diaphragm secured at its edges, and with a thin piece of metal capable of inductive action attached to its centre, opposite an electro magnet in the well-known manner, but he covers the outer surface of this parchment or membraneous diaphragm with a disc of mica, brass, or other equivalent material (that is to say a material not capable of inductive action but which will prevent the passage of moisture to the diaphragm) the said disc being either attached or not to the said diaphragm. By this means he overcomes the difficulty which has hitherto been experienced with this type of telephone, and which is due to the expansion of the parchment or other membrane under the influence of moisture impeding the efficient working of the apparatus, since by this improvement the ingress or action of moisture is prevented and the normal operation of the diaphragm is thus ensured.

681. "Electric meters." C. V. BOYS and H. H. CUNYNGHAME. Dated February 7. 2d. Relates to a construction and arrangement of electric meter or instrument for measuring the electric current passing through a circuit, and to modifications in the construction of electric meters of the kinds described in the Specifications to Letters Patent granted to C. V. Boys on the 13th October, 1881, No. 4472, and on the 19th July, 1882, No. 3434. According to the present invention the inventors cause the current or a known fraction of it to work a small dynamo-electro machine, which, by means of a recoil escapement, drives a heavy balance. The number of revolutions of the machine measures the amount of current passed through it in a given time. The balance, instead of merely presenting mass, of which the inertia and momentum have to be overcome by the power which drives the escapement, may be a magnet armature or may carry an armature subject to the attraction of an electro-magnet excited by the current or a fraction thereof. And in order to avoid complexity the field magnets of the dynamo-electric machine that works the escapement may also serve to act on the balance armature. (*Provisional only.*)

698. "Apparatus or switch for electric lamps, &c." J. T. TOPMAN. Dated February 8. 6d. The object of the invention is to provide a simple and effective apparatus, appliance, or switch, for making and breaking electric contact, and which is particularly applicable to the incandescent lamps, which are fitted to pendants such as those now used as ordinary gas-fittings.

699. "Moulds for moulding or shaping bulbs for incandescent electric lamps, &c." A. SWAN. Dated February 8. 6d. The object of the invention is to provide a mould for moulding or shaping bulbs for incandescent electric lamps or other articles of glass, in which moulds such articles can be blown more perfectly than hitherto without mould marks, or with but little mould marks, that is to say, marks in the glass at the parts corresponding to those at which the junction of the portions of the mould occur.

719. "Electric safety plugs and appliances in connection therewith." K. W. HEDGES. Dated February 9. 6d. According to one part of the present invention, the inventor constructs a safety plug of a number of small wires or strips of lead, tin, or other metal or alloy that melts at a moderate temperature, these wires being laid side by side, but sufficiently far apart to prevent sparking from one to the other, between plates of mica, and having all their ends attached by soldering to two metal terminals which can be connected in the circuit.

764. "Manufacture of carbon filaments for incandescing electric lamps." G. BOWRON and W. HIBBERT. Dated February 12. 6d. Has for its object the production of carbon filaments for incandescing electric lamps of a more homogeneous structure than has been heretofore attainable, whereby increased durability and greater illuminating power for a given unit of surface are obtained. In carrying out the invention, in order to effect this object the inventors make the carbon filaments of a mixture of carbon in a very fine state of division and a viscous liquid of an organic nature, or holding organic substances in solution.

791. "Secondary or storage batteries." T. ROWAN. Dated February 13. 6d. Relates to improvements in the construction of secondary or storage batteries, whereby a larger amount of available internal surface is obtained at a small cost. In carrying out the invention the inventor employs a box or vessel of suitable insulating material, such as ebonite, charikite, or the like, or of wood, iron, or the like, covered with a suitable insulating material. This box or vessel is divided into a suitable number of cells or chambers by walls or partitions of insulating material such as those hereinbefore described. Into these cells or chambers is introduced lead granulated or otherwise divided, and either mixed or not with peroxide of lead. Each cell or chamber thus forms the equivalent of one of the lead plates of an ordinary storage battery, but with greatly increased surface, and in this manner it is possible to form a battery of a material in a divided state instead of, as heretofore, of solid plates covered with divided oxide of lead as a paste, or made to retain the oxide by means of their configuration or by electro deposition.

792. "Dynamo-electric machines and electric-motors, &c." T. ROWAN and S. WILLIAMS. Dated February 13. 6d. Relates partly to further improvements on a former invention, for which provisional protection was granted to the inventors, No. 49, dated January 3rd, 1883.

797. "Dynamo-electric and magneto-electric machinery, &c." F. WYNNE. Dated Feb. 13. 2d. Relates to differential gearing applied to dynamo-electric and magneto-electric machines, which are rotated by electrical currents, and in the means adopted to such machinery for applying such gearing. (*Provisional only*).

833. "Galvanic batteries." F. WALKER. Dated February 15. 2d. The object of the invention is to construct portable electric batteries by means of rendering the excitant into a paste which will absorb the water chemically produced by the electrical action; thereby keeping the paste sufficiently moist for the continuance of such action. The excitant consists of muriate of ammonia dissolved in dilute sulphuric acid, specific gravity 1390, and mixed with powdered gypsum, and oat, wheat, or pea-flour, or lime cement, or similar substances, mixed with water to make a stiff paste, which is poured into the positive element, whilst the negative element is held centrally in position, so that solidification fixes it so.

850. "Electrical self-registering money tills, &c." B. W. WEBB. Dated February 16. 1s. Relates chiefly to improvements in the tills described in the Specification of a former Letters Patent, dated July 8th, 1881, No. 3,009, but the said invention comprises electrical apparatus for automatically registering the amount of money inserted in the said tills, parts of which electrical apparatus are applicable for other purposes.

871. "Incandescent lamps and apparatus employed in conjunction therewith." O. E. WOODHOUSE, F. L. RAWSON, and W. H. COFFIN. Dated February 16. 8d. Relates to a special form of electric lamp particularly adapted for surgical, microscopical, and other scientific purposes, as also to certain apparatus adapted to be used in conjunction with incandescent lamps.

899. "Joint or union contact for electric fittings." W. DEFRIES. Dated February 19. 6d. Relates to an improved joint or union contact which it is proposed to apply as a connection between any parts of the electric circuit where the conducting wires, or the tubes containing them, require to be readily separated, and put together again.

913. "Electrical fuzes and their application to electrical firing." S. J. MACKIE & J. S. WARBURTON. Dated February 19. 2d. Has for its object the greater certainty of ignition of mining and other charges, and the prevention of the dislocation by accident or otherwise of the fuze from its proper position in the explosive charge. *(Provisional only).*

924. "Electric meter." A. S. BUTLER. Dated Feb. 20. 6d. Relates to the construction of an electric meter, in which, by the combined action of a voltameter and a eudiometer on a counting and registering apparatus of any known kind, a record is furnished of the quantity of electricity passed through a circuit in a given time. For this purpose, the inventor leads a shunt from the main circuit through a resistance which, with the other parts of the shunt circuit is adjusted to determine the passage of a known fraction, such as $\frac{1}{100}$th of the total current, so that, by measuring this fraction, the total current can be readily determined. The shunt circuit, after passing the resistance, divides into branches, the one branch leading back to the main circuit through a voltameter, in which two platinum plates are arranged in a vessel containing acidulated water, and the other branch to a contact plate. The voltameter vessel communicates at its upper part with the tube of a eudiometer which is closed at its top, but which at its bottom communicates by a bent tube with a vertical tube containing mercury. The bent tube is charged with liquid, such as bisulphide of carbon, to separate the mercury from the acidulated water in the eudiometer. In the mercury tube there is a float, the stem of which carries a pawl, engaging with the ratchet wheel of a counter, and this stem extends upwards within an adjustable distance of the contact plate above referred to. The mercury in the vessel is electrically connected to one electrode of the primary coil of an inductor, the other electrode of which is connected back to the main circuit. The secondary coil of the inductor is connected to two platinum points in the upper part of the eudiometer. The apparatus acts in the following manner. The water in the voltameter vessel is decomposed by the current passing between the platinum plates, and the oxygen and hydrogen liberated collect in the upper part of the eudiometer producing a pressure which causes the liquid in the eudiometer to descend, and causes the mercury in the tube connected with it to rise. The float is thus raised and the pawl on its stem turns the ratchet wheel of the counter one tooth. The stem, in its farther ascent, meets the contact plate, and thus closes the second branch of the shunt circuit. The current now passes down the float to the mercury, and thence through the primary coil of the inductor, and the current thus induced in the secondary coil, passing as a spark between the platinum points at the top of the eudiometer, fires the gaseous mixture there reproducing the water that had been decomposed. The mercury float now descends opening the inductor branch of the shunt circuit, and the action is continuously repeated, the counter registering the number of times a certain quantity of water is decomposed, and so giving a measure of the electricity that has passed through the voltameter.

927. "Secondary batteries, &c." O. J. LODGE and J. S. PATTINSON. Dated Feb. 20. 4d. The invention comprises the use in secondary batteries of a salt or salts of mercury in solution either alone or in conjunction with sulphate of zinc or other metallic salts in order to amalgamate by means of the forming or charging current the negative plate, or any deposits thereon, which, if deposited under these conditions are amalgamated as deposited.

931. "Printing telegraphs." H. J. ALLISON. (Communicated from abroad by S. D. Field, of America). Dated Feb. 20. Relates to that class of printing telegraphs in which a tendency is given by a motive power to the type-wheel or wheels to constantly rotate, and a magnetic escapement is provided, controlled by currents sent from the transmitting station, so the tendency to continuous rotation is changed into a "step by step" motion.

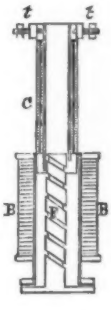
940. "Electric cables or conductors." A. M. CLARK. (Communicated from abroad by Louis Adolphe Fortin-Herrmann, of Paris, France). Dated Feb. 20. Relates to such a construction of the insulating covering of electric conducting wires or cables that the wire or wires shall be bathed in a free circulation of air or gas, or even a liquid within an external envelope or tube.

945. "Tanning leather by electricity." L. GAULARD. Dated Feb. 20. 4d. Relates to improvements in the method described in a patent obtained on the 19th September, 1877, in which is claimed the application of the decomposition of water by means of electricity to the tanning of leather.

951. "Electric arc lamp." H. TROTT and C. F. FENTON. Dated Feb. 21. 2d. Relates firstly to a mode of regulating the feed of carbons of an electric arc lamp by means of a flat horse-shoe magnet wound with coarse and fine wire, the fine being laid in an opposite direction to the coarse.

1015. "Galvanic batteries." O. C. D. ROSS. Dated Feb. 24. 2d. The objects of the invention are improvements in galvanic batteries, and chiefly in regard to arrangements of the cells composing such batteries. *(Provisional only).*

1020. "Applying variable resistance to electric currents without commutator." L. GAULARD and J. D. GIBBS. Dated Feb. 24. A fine copper wire covered with silk, and with disconnected extremities, is wound upon a cylinder of wood or cardboard, the diameter of which varies according to the power it is desired to give to the apparatus, which diameter for example may be one centimetre with a length of four centimetres—in the axis of this coil and fixed to one of its extremities, is placed a small cylinder of soft iron, say five millimetres in diameter, upon which is formed a screw thread. Upon another cylinder composed of wood or cardboard, and say five millimetres in diameter, are wound two superposed series of coils of copper wire, also insulated, and the extremities of which are connected at the upper part of this cylinder with two binding screws or terminals. This cylinder so formed is capable of sliding between the internal sides of the coil firstly described upon the screw thread on the rod arranged on its axis. In the annexed drawing, B is the external coil, C the internal coil, the two extremities, *t*, *t*, of which are connected with the circuit of the current to which the resistance is to be opposed. F is the rod of soft iron. From the foregoing description, it will be readily understood that the resistance opposed to the current passing in the circuit, C, will be in proportion to the extent to which this circuit is caused to enter the interior of the coil, B.



CORRESPONDENCE.

Science Certificates.

Now that the season of activity in the matter of technical education has again arrived, it may not be out of place to remark upon one or two points in connection with this subject.

With regard to the South Kensington and kindred examinations, it seems to me an open question whether the classes are to be considered as attendants on the examinations or the examinations as the outcome of the classes. If the former, it is certainly time that something was done to render the certificates obtained at those examinations of some practical value; but if the latter, it is to the classes themselves that reform must come. When a student has studied his particular subject, and has taken, say, a C. and G. certificate in honours for telegraphy—except as an ornament—of what further use will it be to him? Is it not a melancholy fact that these pieces of paper, which he has

worked so hard to obtain, are, so to speak, "NOT NEGOTIABLE?" The question undoubtedly is how to deal with the subject under consideration so as to give the student a testimonial which shall speak to his *practical* knowledge of technology. I am speaking of the highest, rather than the lower, of the technological, rather than the pure science, certificates, which are of necessity only "stepping stones to higher things."

The "honour's" technical certificate should, in my opinion, embody in a reasonable form the principle that an ounce of practice is worth a pound of theory. It should testify that the candidate really and, moreover, usefully understands the various processes of testing, localising, and adjusting, such as would fall within the routine of a cable office. He must, in short, be able not only to talk about his acquirements but apply them, and then, but not until then, will the high certificates of the examining bodies be worth the paper they are printed on.

Alejandro Iglesia.

30, Bardolph Road, London, N.,
Oct. 24th, 1883.

Underground Conductors.

I am preparing a report on underground conductors for the transmission of electric light and power in England and on the Continent. It has been stated in America that no regular system of underground conductors is in use in Europe, large subways, tunnels, sewers, &c., being utilised for this purpose. My impression is that this statement is erroneous, and I am endeavouring to collect a few statistics on the subject.

Not being able to reach personally all the firms and private individuals using the electric light, and who may have put down underground mains, I venture to appeal to them through your columns to assist me in this matter of great scientific interest by furnishing some of the following particulars to the address given below:—

1. Locality of line.
2. Length of line.
3. Approximate cost of line.
4. Length of time at work.
5. Purpose used for; arc or incandescent lighting or motors.
6. Particulars of lamps or motors.
7. Nature of insulation, thickness and cost of same.
8. Some particulars as to bed of line.
9. Accidents, stoppages, or delays, if any, and their causes.
10. Any specialities used, such as junction boxes, cut outs, fusible plugs, alarms, &c.
11. Advantages of this line.
12. Nature of ground—wet or dry.

As these particulars are wanted purely as scientific matters, and not for business use, I trust those of your readers who can do so will oblige me by sending them at their earliest convenience.

Apologising for taking up so much of your valuable space.

C. R. Heap.

Archway House,
Bush Lane, Cannon Street,
Oct. 24th, 1883.

Jablochkoff Electric Light and Power Company, Limited.

It appears to me that, as the result of the 15 months' trading has been a loss of nearly £15,000, it would not be inappropriate for the directors, who are men of position, to refund the £2,806 which they took in fees, and I imagine that this suggestion only requires to be made to be acted upon by them. With the capital light they have it ought not to be long before the company is brought into a paying condition, and I am sure that this action on the part of the directors would give additional confidence to the present shareholders to subscribe for the debenture stock.

Electric Light.

October 30th, 1883.

Telephone Patents.

Patent No. 965, Feb. 21st, 1883, issued to A. F. St. George, for "Improvements in methods of and apparatus for transmitting audible signals by means of electricity." The transmitting device is described in the specifications in these words:—

"In order to transmit the sounds of the human voice I prefer to employ a carbonized disc so prepared, mounted by its edges in a frame or support between suitable rings or washers, and sometimes I employ a mouthpiece to cause sounds to impinge upon the disc with increased force. The disc so mounted is placed in a suitable containing case with an aperture to admit of sound waves impinging upon it.

"I prefer to connect the disc to the circuit in which it is to operate by means of copper electro-plated upon a small portion of the disc, preferably the edge, and to the electro-film of metal which must be in rigid contact with the disc I solder a connecting wire for connection with the circuit. I arrange a ball of the hardest quality of carbon hanging by a thin metallic wire or by a flexible non-metallic thread, and this ball is arranged so as to touch lightly against the surface of the carbonized disc. I connect the ball to the electrical circuit by means of the thin metallic wire (or if a non-metallic thread is used by a separate metallic wire of extreme flexibility) and the circuit is completed by the contact of the ball with the surface of the carbonised disc.

"Sounds made to impinge upon the apparatus agitate the disc and the ball touching it, so that the ball follows all movements of the disc and always is in contact with it, but whilst the disc vibrates the ball makes small excursions about the surface of the disc, that is to say, any movement of the disc causes the ball to roll about its surface, and this rolling action of the ball brings into circuit from time to time fresh points of contact in the path of the current of electricity.

"The transmitting apparatus described is connected with a battery and conducting wire forming a complete circuit and vibrations of the apparatus produced by sound will set up electrical variations, which, at a distant point of the circuit, may be resolved into corresponding sounds in a receiving telephone."

This device is clearly the combination of a diaphragm or tympan with a tension regulator, and is identical with a transmitter invented by Berliner, which is thus described:—"The microphonic contact of the transmitter is made by a ball of carbon suspended from both ends of its axle, and lying against a plate of hard carbon fixed to a vibrating diaphragm."

The receiver is thus described:—

"It consists of two or more discs of mica arranged parallel with, and in close proximity to, each other, and suitably mounted by their edges so as to be free to vibrate. One side of each disc of mica is coated by electro-deposition with metal, preferably silver, and the discs are preferably perforated at their centre.

"I sometimes use frictional electricity instead of electricity generated from a galvanic battery in order to transmit messages through telephones of the kind described. For this purpose I make the transmitting instrument of a disc of mica coated with conducting material as already described, to which disc electricity is conveyed by a conducting wire from the receiver of any ordinary suitable frictional electrical machine. This disc is adjusted in a suitable support parallel with and in close proximity to a corresponding disc or block with which the insulated wire of the telephone circuit is connected. The other end of the wire is connected with a similar disc or block supported parallel with and in sufficiently close proximity to a second telephone disc or diaphragm. When a charge of electricity is supplied from the machine to the first or transmitting disc, and the latter is made to vibrate by the human voice or other sounds, corresponding undulations of electricity are caused in the wire of the circuit, and in the second or receiving block the telephone disc or diaphragm in proximity with which is attracted at each such undulation, and the sounds transmitted from the first disc are thus reproduced."

A comparison of the drawings representing this receiver with the drawings of the receiver in Dolbear's patent, No. 1395, March 29th, 1881, shows the two instruments to be identical in principle, action and construction.

Common Sense.

Oct. 29th, 1883.

A use for the Steam Engine Indicator.

The article upon the "Use for the Steam Engine Indicator," which appeared upon page 319 of your last issue, is very interesting to all electrical engineers, especially those who have practically studied the action of the steam engine. But though it is certainly due to Mr. Grimshaw, M.E., to state that he is the first to my knowledge, who has given publicity to this new use of the indicator, it is not entirely original, for I have several times applied Richards' instrument for the purpose of discovering a "knock," which could not be located, either by the ordinary diagram or sounding rod.

For this application I made a brass collar, bored so as to be an easy fit upon the cylinder of the indicator, below the arm, and which was fitted with a set screw for adjustment. A spring upon this collar pressed the arm, carrying the levers and pencil, lightly upon the card. While taking the ordinary diagram, I placed the arm at right angles to the stroke line, then, keeping the card still upon the instrument I adjusted the pencil by the screw upon the piston rod of the indicator, so as to be about $\frac{1}{16}$ inch above the atmospheric line, previously drawn. Then setting the loose collar, so that the spring upon it pressed the pencil lightly upon the card, I attached a fine steel wire to the short end of the arm, bringing it over the crank shaft and hanging a weight upon it to maintain the tension of the wire, without moving the pencil from the card, against the spring. Now, allowing the card to revolve again, if there be no lost motion, an unbroken line will be drawn, parallel to, and $\frac{1}{16}$ above the line of no pressure, but where such lost motion occurs, the line will be interrupted, and the position of the space so formed correctly determines the period of irregularity during the stroke, as it corresponds with the diagram.

It is evident that this method will show a vertical as well as an horizontal vibration, and this is very important when testing high speed condensing engines where the air pump is vertical, and often arranged with a view to balance the crank, which is erroneous, and often a source of trouble.

I once had to indicate a 60 H.P. horizontal condensing engine, running at 85 revolutions per minute, which knocked loudly at each stroke, but neither rod nor diagram showed any fault, but the simple apparatus I have just described localized the mischief, and by taking a diagram from the air pump the exact cause was at once apparent, and soon remedied by the application of an air vessel to the rather long delivery pipe.

Anyone who has had any experience with high speed steam engines must have been troubled more or less with that annoying "thump," so disagreeable to the ears of an engineer. Sometimes this is caused by insufficient lead, cushioning, or defective exhaust, or even water; in such cases the ordinary diagram at once points to the fault, but it often happens that with a good condition of valve, piston and bearings, there is still the obstinate knock, apparently irremediable, and it is with a lively recollection of such troubles that I venture to trespass upon your space in describing my application of the ordinary indicator.

Fredk. Walker.

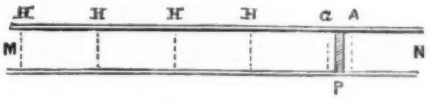
3, St. Loy's Road, Bruce Grove, N.,
Oct. 27th, 1883.

The Hammer Telephone.

With reference to the above, since M. De Locht-Labye wishes it, I will endeavour as briefly as possible to expound my views upon the subject.

It is generally admitted that sound is the sensation produced upon the brain by a series of vibrations or oscillations of the particles of air or other surrounding and elastic body, being communicated by means of the auditory nerve, and further, that the particles do not all vibrate simultaneously, but the motion or impulse is communicated from one to another, producing, as a natural consequence, condensations and rarefactions. That sound is propagated in this manner is evident from the following extract from Ganot's "Physics," ninth edition, page 176: "Let M, N be a tube filled with air at a constant pressure and temperature, and let P be a piston oscillating rapidly from A to *a*.

When the piston passes from A to *a*, it compresses the air in the tube. But in consequence of the great compressibility, the condensation of the air does not take place at once throughout the whole length of the tube, but solely within a certain length, *a* H, which is called the condensed wave.



If the tube, M, N, be supposed to be divided into layers parallel to the piston, it may be shown by calculation, that when the first layer of the wave, *a* H, comes to rest, the motion is communicated to the first layer of the second wave, H H′, and so on, from layer to layer, in all parts of H′ H″, H″ H‴. The condensed wave advances in the tube, each of its parts having successively the same degree of velocity and condensation.

When the piston returns in the direction *a* A, a vacuum is produced behind it, which causes an expansion of the air in contact with its posterior face. The next layer, expanding in turn, brings the first to its original state of condensation, and so on, from layer to layer. Thus, when the piston has returned to A, an *expanded wave* is produced of the same length as the condensed wave, and directly following it in the tube where they are propagated together, the corresponding layers of the two waves possessing equal and contrary velocities.

This is precisely what occurs in the telephone in question.

When used as a transmitter, the organ, of wood or other suitable material, receives the impulses from the surrounding atmosphere and vibrates not as a whole simultaneously, but the layer of particles nearest the vibrating body first takes them up and communicates them to the next layer, and so on, through the whole substance, until the hammer or lever is reached, which, being free to move, undergoes bodily as well as molecular displacement. But *only in proportion to the elasticity of the organ*, from which *I imagine it never separates*, and the armature approaches or recedes from the poles of the magnet, in proportion to the amount of bodily displacement, at the same time the molecular disturbance renders it (the armature) more susceptible to magnetic changes, the combined effect of which is to vary the intensity and position of the lines of force passing through or across the coils; thus giving rise to a series of *undulatory* currents, which passing along the line in precisely the same order as produced, alternately increase and diminish the strength of the magnetic field of the receiver, reproducing in the hammer and organ a fac-simile of the impulses transmitted, an impulse being communicated by the *magnetising* as well as the demagnetising current, the former by increasing, and the latter by relieving the strain upon the organ.

F. W. Cooke, A.S.T.E. & E.

G.N.R., Retford,
Oct. 29th, 1883.

Undulatory Current.

Your correspondents are hunting what they call the undulating current at the transmitting end of a telephonic circuit, let them go to the other end, and take a Hammer telephone or any of the telephones

which M. du Moncel calls "Téléphones fondés sur des effets autres que ceux qui sont en jeu dans le téléphone Bell" and there they will hear the words spoken to the transmitter rendered to them by reiterated shocks or blows. As it is claimed that whatever is put into the transmitter, comes out at the receiver in the same character that it is put in; so it would appear that the current called undulating, requires to have its name modified.

H. G. Y.

29th Oct., 1883.

The "Review" of Professor S. P. Thompson's book on Reis in "Science."

The weight to be given to the criticisms of a reviewer of a work treating of scientific facts and opinions derives importance either from the acknowledged scientific attainments of the reviewer, or from his array of well-established facts to support his opinions. In the "review," published originally in a periodical entitled *Science*, both those essentials are wanting to entitle it to any importance whatever.

In the first place, that review does not bear the signature of the writer. For the importance of the opinions expressed in this publication we must fall back upon those responsible for its publication.

Their names are displayed on the cover of the work and are as follows :—

*The Science Company.—Directors: D. C. Gilman, of Baltimore, *President;* A. Graham Bell, of Washington, *Vice-President;* †G. G. Hubbard, of Washington; O. C. Marsh, of New Haven; S. H. Scudder, of Cambridge, *Editor*. Moses King, of Cambridge, *Publisher*.

Now, as the "review" is a defence of Bell's claim to be the inventor of the telephone as against the claim advanced by Professor Thompson that Reis is the inventor, it is evident that the reviewer is writing in his own interest, and certainly his opinions are not to be accepted, unless sustained by proofs, and the only pretension they can possess to be entitled to any weight must depend upon the facts cited in support of his opinion.

I forbear to comment upon the many erroneous statements made by the reviewer because of a well-known legal axiom—"*falsus in uno, falsus in omnibus*"—and further, because of his crass ignorance of facts long since well established.

The reviewer writes: "To say, as Prof. Thompson repeatedly does, that Reis employed his mechanism with the express intention of 'producing a variable current by the change of contact-resistance,' and that he consciously and purposely utilised this principle—at that time hardly recognised anywhere, and of which 'the practical application was not discovered till several years later'—is a gross misrepresentation, and an utter perversion of the facts. Reis did not know, and could not know, that the strength of a current could be controlled by the varying pressure of the conducting-surfaces between which it passes."

The scientific acquirements of the reviewer can be estimated by reference to the 2nd edition of Count du Moncel's "Exposé des applications de l'Electricite," page 246, published in 1856, as follows :—

"A curious fact, and one which seems at first to be contradictory to the theory which has been formed of electricity is, that *the pressure, more or less, which is imparted between the contacts of the interrupters has considerable influence on the intensity of the currents which pass through them.* This is owing to the fact that the metals are not always in a perfect state of cleanliness at the point of contact, but, perhaps, also *to a physical cause not as yet well understood.*"

The reason the reviewer gives that "Reis did not know, and could not know, that the strength of a current could be controlled by varying the pressure of the conducting surfaces through which it passes," can only be that he himself was ignorant of that principle, which was published, in 1856, in a book of world-wide fame and circulation.

To him I think I can apply with justice the following words, applied by him to Professor Thompson, "The least that can be said of such evidence is, that it totally destroys the credibility of the witness, and nullifies his claim to be accepted as a scientific authority."

W. C. Barney.

Oct. 28th, 1883.

P.S.—May I ask you to publish some extracts from a review of Professor Thompson's book by Dr. William F. Channing, an eminent scientist, to whom Mr. Bell, in his paper read before the Society of Telegraph Engineers, Oct. 31, 1877, expressed his indebtedness for his co-operation and assistance.

[In compliance with Mr. Barney's request, we give below the extracts to which he refers, and, in regard to the review in *Science*, we presume it was written editorially, there being no name attached thereto.—EDS. ELEC. REV.]

Prof. Thompson's book, which treats exhaustively the early history of the telephone, is, therefore, not only of scientific but of social interest and importance. It establishes beyond honest doubt or question, by historical evidence, by the reproduction of original documents and illustrations, and by the public records of scientific bodies, that Philipp Reis discovered *the electric transmission of speech* in 1860-61; that he elaborately described and exhibited his telephone in 1861; that he invented transmitting and receiving instruments, which not only talked then and talk now, but which include the essential principles of the transmitters and receivers now in use; and that he manufactured, placed on the market, and sold his instruments in 1863, for the purpose of illustrating the electric transmission of speech and song. That an invention so important, made in the heart of Germany, should not have been instantly perfected and utilised would surprise us in this country, if history did not abundantly teach that inventions complete in themselves often lie sterile until the favourable season and soil are found for their commercial adoption and development.

In an appendix, which is not really separable from nor less important than the rest of the work, Prof. Thompson discusses the relation of Reis's instruments to those now in use, and also Reis's development and use of the variable or "undulatory" electric current, corresponding to the undulatory curves of sound-pressure, which he graphically represents, and to which he often refers.

Disregarding induction-coils and other accessories, the fundamental principle of these later instruments is the combination of a tympanum with a current-regulator, identical with the combination used by Reis. Too loud shouting in either the Reis or Blake transmitters spoils the articulation by breaking the circuit.

Reis's transmitters have been called make and break circuit instruments. If so, the Berliner and Blake transmitters, operating on the same principle, are also make and break circuit instruments. If, on the other hand, the Berliner and Blake transmitters, by their current-regulators, determine undulatory electric currents, in correspondence with the sound-waves, the Reis transmitters, by the same mechanism, necessarily do the same.

A section in the appendix is devoted to the "undulatory current in Reis's telephone. We have already seen that the function of the Reis transmitter was to vary the strength of the electric current, and not to break it. Reis was accustomed to speak of opening and closing the circuit in describing these instruments, not in the technical sense of modern telegraphy, nor with the idea of sending intermittent signals, but in the sense of increasing or diminishing the current, without going so for as absolutely to break it. This is abundantly proved by the context in his descriptions, and by the operation of his instruments. He states, in his first memoir, that to reproduce any sound, or combination of sounds, all that is necessary is to set up in the receiver vibrations whose curves are identical with those of the sounds, or combination of sounds, in the transmitter. And he represents graphically the undulatory curves of consonant and vowel sounds by way of illustration. Between the transmitter and receiver, on whose necessary identity of vibrations he constantly insists, he employs an electric current as the intermediate, to take on, in its wave-motions or polarisations, all the possible variations of the sound-waves striking on the transmitter, and to give them up again to the receiver. Reis, without talking about "undulatory" currents, makes them the staple of his telephone.

Prof. Thompson, without the least imputation of plagiarism, shows, in parallel columns, the identity of expression between Reis and Bell, in their statement of the essential principles of the telephone. The impression of the identity of Reis's and Bell's discovery grows, page by page, during the perusal of this book.

The conclusion reached by Prof. Thompson, from the survey of the whole field—a conclusion which seems to be fully borne out by the facts adduced—is the following: "There is not in the telephone exchanges of England to-day any single telephone to be found in which the fundamental principles of Reis's telephone are not the essential and indispensable features."

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* A new company formed lately, evidently in the interest of the Bell Telephone Company.

† G. G. Hubbard, father-in-law of A. G. Bell, and well known as being interested in many companies formed to exploit Bell telephones.